17 NOVEMBER 2025

EHRM INFRASTRUCTURE UPGRADES

PROJECT #: 405-22-700

VA MEDICAL CENTER WHITE RIVER JUNCTION,
WHITE RIVER JUNCTION, VT

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100% SUBMITTAL
CONSTRUCTION DOCUMENT 2

SDB SPEESDESIGNBUILD

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SEALS PAGE

CERTIFICATION

The technical material and data contained in these Contract Documents were prepared under the supervision and direction of the undersigned, whose seal, as a licensed professional to practice as such, is affixed below.

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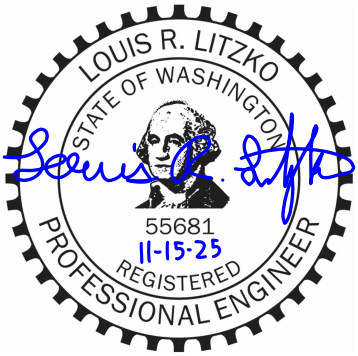

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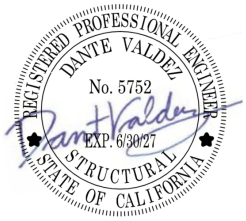

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VHA MASTER SPECIFICATIONS

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001M-405 333	BLDG 001 - LVL 03 - ENLARGED MECHANICAL PLAN - RM 331-
001M-406	BLDG 001 - LVL 03 - ENLARGED DEMOLITION MECHANICAL PLAN - RM 336A-336F - PHASE 01
001M-407	BLDG 001 - LVL 03 - ENLARGED MECHANICAL PLAN - RM 336A-336F - PHASE 01
001M-408	BLDG 001 - LVL 03 - ENLARGED DEMOLITION MECHANICAL PLAN - RM 336A-336F - PHASE 02
001M-409	BLDG 001 - LVL 03 - ENLARGED MECHANICAL PLAN - RM 336A-336F - PHASE 02
001M-410	BLDG 001 - LVL 03 - ENLARGED DEMOLITION MECHANICAL

	PLAN - RM 336A-336F - PHASE 03
001M-411	BLDG 001 - LVL 03 - ENLARGED MECHANICAL PLAN - RM 336A-336F - PHASE 03
001M-412	BLDG 001 - ATTIC - PARTIAL MECHANICAL PLAN - PHASE 01
001M-413	BLDG 001 - ATTIC - PARTIAL MECHANICAL PLAN - PHASE 02
002M-401	BLDG 002 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 107
004M-401	BLDG 004 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 105
006M-401	BLDG 006 - LVL 00 - ENLARGED MECHANICAL PLAN - RM B1A
007M-401	BLDG 007 - LVL 00 - ENLARGED MECHANICAL PLAN - RM B3
009M-401	BLDG 009 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 103
028M-401	BLDG 028 - LVL 00B - ENLARGED MECHANICAL PLAN - RM 03
028M-402	BLDG 028 - LVL 00G - ENLARGED MECHANICAL PLAN - RM G31
028M-403	BLDG 028 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 115A
028M-404	BLDG 028 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 219
028M-405	BLDG 028 - LVL ATTIC - ENLARGED MECHANICAL PLAN - RM 29
031M-401	BLDG 031 - LVL 00B - ENLARGED MECHANICAL PLAN - RM B-19B
031M-402	BLDG 031 - LVL 00B - FLOOR MECHANICAL PLAN - RM B-13
031M-403	BLDG 031 - LVL 00G - ENLARGED MECHANICAL PLAN - RM G12
031M-404	BLDG 031 - LVL 01 - ENLARGED MECHANICAL PLAN - PIPE ROUTING
031M-405	BLDG 031 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 226
031M-406	BLDG 031 - PENTHOUSE A - ENLARGED MECHANICAL PLAN – PHASE 01
031MD-407	BLDG 031 - PENTHOUSE A - ENLARGED MECHANICAL DEMOLITION PLAN – PHASE 02
031MD-408	BLDG 031 - PENTHOUSE A - ENLARGED MECHANICAL DEMOLITION PLAN - PHASE 03
037M-401	BLDG 037 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 200A
037M-402	BLDG 037 - LVL 02 - ENLARGED MECHANICAL PLAN - PARTIAL PLAN
039M-401	BLDG 039 - LVL 00 - ENLARGED MECHANICAL PLAN - RM G05
039M-402	BLDG 039 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 132
039M-403	BLDG 039 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 200A

039M-404	BLDG 039 - LVL 03 - ENLARGED MECHANICAL PLAN - RM 387
039M-405 PENTHOUSE	BLDG 039 - LVL 03 - ENLARGED MECHANICAL PLAN -
044M-401	BLDG 044 - LVL 00 - ENLARGED MECHANICAL PLAN - RM G-115
044M-402 PLAN	BLDG 044 - LVL 00 - ENLARGED MECHANICAL PLAN - PARTIAL
044M-403	BLDG 044 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 1-118
044M-404	BLDG 044 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 2-114B
044M-405 PLAN	BLDG 044 - PENTHOUSE - ENLARGED MECHANICAL PARTIAL
065M-401	BLDG 065 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 119
066M-401	BLDG 066 - LVL 01 - ENLARGED MECHANICAL PLAN - RM B1007
067M-401 PLAN	BLDG 067 - LVL 00G - ENLARGED MECHANICAL PLAN - PARTIAL
067M-402	BLDG 067 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 1109
088M-401	BLDG 088 - LVL 00 - ENLARGED MECHANICAL PLAN - RM G123
088M-402	BLDG 088 - LVL 01 - ENLARGED MECHANICAL PLAN - RM 1105A
T59M-401 PLAN	BLDG T59 - LVL 01 - ENLARGED MECHANICAL PLAN - PARTIAL
T59M-402	BLDG T59 - LVL 02 - ENLARGED MECHANICAL PLAN - RM 205
T62M-401	BLDG T62- LVL 00 - ENLARGED MECHANICAL PLAN - RM B100
T63M-401	BLDG T63 - LVL 00 - ENLARGED MECHANICAL PLAN - RM B01
F-501	FIRE PROTECTION DETAILS I
M-501	MECHANICAL DETAILS I
M-502	MECHANICAL DETAILS II
M-503	MECHANICAL DETAILS III
M-504	MECHANICAL DETAILS IV
M-601	MECHANICAL SCHEDULES I
M-602	MECHANICAL SCHEDULES II
M-701	MECHANICAL CONTROLS I
M-702	MECHANICAL CONTROLS II
M-703	MECHANICAL CONTROLS III
	ELECTRICAL
EPG001	ABBREVIATIONS AND GENERAL NOTES

EPG002	ELECTRICAL LEGENDS
001EP100	BLDG 001 - LEVEL 00 - ELECTRICAL PLAN
001EP101	BLDG 001 - LEVEL 01 - ELECTRICAL PLAN
001EP102	BLDG 001 - LEVEL 02 - ELECTRICAL PLAN
001EP103	BLDG 001 - LEVEL 03 - ELECTRICAL PLAN
001EP400a	BLDG 001 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
001EP400b	BLDG 001 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
001EP401	BLDG 001 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
001EP402	BLDG 001 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
001EP403	BLDG 001 - LEVEL 03 - ENLARGED ELECTRICAL PLANS
001EL403a	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 LIGHTING PLANS
001EL403b	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 LIGHTING PLANS
001EL403c	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 LIGHTING PLANS
001EP403a	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 POWER PLANS
001EP403b	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 POWER PLANS
001EP403c	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 POWER PLANS
001EP403d	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 MECHANICAL POWER PLANS
001EP403e	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 MECHANICAL POWER PLANS
001EP403f	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 MECHANICAL POWER PLANS
001EP403g	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 RECEPTACLE PLANS
001EP403h	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 RECEPTACLE PLANS
001EP403i	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 RECEPTACLE PLANS
001EB403a	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 ELECTRICAL BONDING PLANS
001EB403b	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 ELECTRICAL BONDING PLANS
001EB403c	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 ELECTRICAL BONDING PLANS
001EF403a	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 FIRE ALARM PLANS
001EF403b	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 FIRE ALARM PLANS
001EF403c	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 FIRE ALARM PLANS
002EP101	BLDG 002 - LEVEL 01 - ELECTRICAL PLAN

002EP401	BLDG 002 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
004EP100	BLDG 004 - LEVEL 00 - 01 & 02 - ELECTRICAL PLAN
004EP400	BLDG 004 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
004EP401	BLDG 004 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
006EP100	BLDG 006 - LEVEL 00 - 01 & 02 - ELECTRICAL PLAN
006EP400	BLDG 006 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
007EP400	BLDG 007 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
009EP100	BLDG 009 - LEVEL 00 - 01 & 02 - ELECTRICAL PLAN
009EP401	BLDG 009 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
028EP100B	BLDG 028 - LEVEL 00B - ELECTRICAL PLAN
028EP102	BLDG 028 - LEVEL 02 - ELECTRICAL PLAN
028EP103	BLDG 028 - ATTIC - ELECTRICAL PLAN
028EP400B	BLDG 028 - LEVEL 00B - ENLARGED ELECTRICAL PLANS
028EP400G	BLDG 028 - LEVEL 00G - ENLARGED ELECTRICAL PLANS
028EP401	BLDG 028 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
028EP402	BLDG 028 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
031EP100B	BLDG 031 - LEVEL 00B - ELECTRICAL PLAN
031EP100G	BLDG 031 - LEVEL 00G - ELECTRICAL PLAN
031EP101	BLDG 031 - LEVEL 01 - ELECTRICAL PLAN
031EP102	BLDG 031 - LEVEL 02 - ELECTRICAL PLAN
031EP103	BLDG 031 - PENTHOUSE A - ELECTRICAL PLAN
031EP400Ba	BLDG 031 - LEVEL 00B - ENLARGED ELECTRICAL PLANS
031EP400Bb	BLDG 031 - LEVEL 00B - ENLARGED ELECTRICAL PLANS
031EP400G	BLDG 031 - LEVEL 00G - ENLARGED ELECTRICAL PLANS
031EP402	BLDG 031 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
037EP102	BLDG 037 - LEVEL 02 - ELECTRICAL PLAN
037EP402	BLDG 037 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
039EP100	BLDG 039 - LEVEL 00 - ELECTRICAL PLAN
039EP101	BLDG 039 - LEVEL 01 - ELECTRICAL PLAN
039EP102	BLDG 039 - LEVEL 02 - ELECTRICAL PLAN
039EP103	BLDG 039 - LEVEL 03 - ELECTRICAL PLAN
039EP104	BLDG 039 - PENTHOUSE - ELECTRICAL PLAN
039EP400a	BLDG 039 - LEVEL 00 - ENLARGED ELECTRICAL PLANS

039EP400b	BLDG 039 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
039EP401	BLDG 039 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
039EP402	BLDG 039 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
039EP403	BLDG 039 - LEVEL 03 - ENLARGED ELECTRICAL PLANS
044EP100	BLDG 044 - LEVEL 00 - ELECTRICAL PLAN
044EP101	BLDG 044 - LEVEL 01 - ELECTRICAL PLAN
044EP102	BLDG 044 - LEVEL 02 - ELECTRICAL PLAN
044EP103	BLDG 044 - PENTHOUSE - ELECTRICAL PLAN
044EP400a	BLDG 044 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
044EP400b	BLDG 044 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
044EP401	BLDG 044 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
044EP402	BLDG 044 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
065EP101	BLDG 065 - LEVEL 01 - ELECTRICAL PLAN
065EP401	BLDG 065 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
066EP100	BLDG 066 - LEVEL 00 - ELECTRICAL PLAN
066EP101	BLDG 066 - LEVEL 01 - ELECTRICAL PLAN
066EP401	BLDG 066 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
067EP100G	BLDG 067 - LEVEL 00G - ELECTRICAL PLAN
067EP401	BLDG 067 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
088EP100	BLDG 088 - LEVEL 00 - ELECTRICAL PLAN
088EP400	BLDG 088 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
088EP401	BLDG 088 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
T59EP101	BLDG T59 - LEVEL 01 - ELECTRICAL PLAN
T59EP402	BLDG T59 - LEVEL 02 - ENLARGED ELECTRICAL PLANS
T62EP100	BLDG T62 - LEVEL 00 - ELECTRICAL PLAN
T62EP400	BLDG T62 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
T63EP100	BLDG T63 - LVL 00 - 01 & 02 - ELECTRICAL PLANS
T63EP400	BLDG T63 - LEVEL 00 - ENLARGED ELECTRICAL PLANS
T63EP401	BLDG T63 - LEVEL 01 - ENLARGED ELECTRICAL PLANS
EP501	ELECTRICAL DETAILS
EP502	ELECTRICAL DETAILS
EP503	ELECTRICAL DETAILS
EP504	ELECTRICAL DETAILS

EP505	ELECTRICAL DETAILS
EP506	ELECTRICAL DETAILS
EP507	ELECTRICAL DETAILS
EP508	ELECTRICAL DETAILS
EP509	ELECTRICAL DETAILS
EP510	ELECTRICAL DETAILS
EF601	FIRE ALARM RISER DIAGRAM
EG601	TELECOMMUNICATIONS BONDING RISER DIAGRAM
EG602	TELECOMMUNICATIONS BONDING RISER DIAGRAM
000EP601	MEDIUM VOLTAGE - ONE-LINE DIAGRAM
001EP601	BLDG 001 - ONE-LINE DIAGRAM - PART 1 OF 5
001EP602	BLDG 001 - ONE-LINE DIAGRAM - PART 2 OF 5
001EP603	BLDG 001 - ONE-LINE DIAGRAM - PART 3 OF 5
001EP604	BLDG 001 - ONE-LINE DIAGRAM - PART 4 OF 5 - DATA CENTER
001EP605	BLDG 001 - ONE-LINE DIAGRAM - PART 5 OF 5 - DATA CENTER
002EP601	BLDG 002 - ONE-LINE DIAGRAM
004EP611	BLDG 004 - ONE-LINE DIAGRAMS
006EP601	BLDG 006 - ONE-LINE DIAGRAMS
007EP601	BLDG 007 - ONE-LINE DIAGRAMS
009EP601	BLDG 009 - ONE-LINE DIAGRAM
028EP601	BLDG 028 - ONE-LINE DIAGRAM
031EP601	BLDG 031 - ONE-LINE DIAGRAM - PART 1 OF 4
031EP602	BLDG 031 - ONE-LINE DIAGRAM - PART 2 OF 4
031EP603	BLDG 031 - ONE-LINE DIAGRAM - PART 3 OF 4
031EP604	BLDG 031 - ONE-LINE DIAGRAM - PART 4 OF 4
037EP601	BLDG 037 - ONE-LINE DIAGRAM
039EP601	BLDG 039 - ONE-LINE DIAGRAM
044EP601	BLDG 044 - ONE-LINE DIAGRAM - EXISTING
044EP611	BLDG 044 - ONE-LINE DIAGRAM - REVISED
065EP601	BLDG 065 - ONE-LINE DIAGRAM
066EP601	BLDG 066 - ONE-LINE DIAGRAMS
067EP601	BLDG 067 - ONE-LINE DIAGRAM
088EP601	BLDG 088 - ONE-LINE DIAGRAM

T59EP601	BLDG T59 - ONE-LINE DIAGRAM
T62EP601	BLDG T62 - ONE-LINE DIAGRAM
T63EP601	BLDG T63 - ONE-LINE DIAGRAMS
EP701	ELECTRICAL SCHEDULES
001EP701	BLDG 001 - ELECTRICAL SCHEDULES
001EP702	BLDG 001 - ELECTRICAL SCHEDULES
001EP703	BLDG 001 - ELECTRICAL SCHEDULES
001EP704	BLDG 001 - ELECTRICAL SCHEDULES
001EP705	BLDG 001 - ELECTRICAL SCHEDULES
002EP701	BLDG 002 - ELECTRICAL SCHEDULES
004EP701	BLDG 004 - ELECTRICAL SCHEDULES
006EP701	BLDG 006 - ELECTRICAL SCHEDULES
007EP701	BLDG 007 - ELECTRICAL SCHEDULES
009EP701	BLDG 009 - ELECTRICAL SCHEDULES
028EP701	BLDG 028 - ELECTRICAL SCHEDULES
028EP702	BLDG 028 - ELECTRICAL SCHEDULES
031EP701	BLDG 031 - ELECTRICAL SCHEDULES
031EP702	BLDG 031 - ELECTRICAL SCHEDULES
037EP701	BLDG 037 - ELECTRICAL SCHEDULES
039EP701	BLDG 039 - ELECTRICAL SCHEDULES
039EP702	BLDG 039 - ELECTRICAL SCHEDULES
044EP701	BLDG 044 - ELECTRICAL SCHEDULES
044EP702	BLDG 044 - ELECTRICAL SCHEDULES
065EP701	BLDG 065 - ELECTRICAL SCHEDULES
066EP701	BLDG 066 - ELECTRICAL SCHEDULES
067EP701	BLDG 067 - ELECTRICAL SCHEDULES
088EP701	BLDG 088 - ELECTRICAL SCHEDULES
T59EP701	BLDG T59 - ELECTRICAL SCHEDULES
T62EP701	BLDG T62 - ELECTRICAL SCHEDULES
T63EP701	BLDG T63 - ELECTRICAL SCHEDULES

TELECOMMUNICATIONS

TNG001	ABBREVIATIONS AND GENERAL NOTES
TNG002	TELECOMMUNICATIONS LEGENDS
001TN100	BLDG 001 - LEVEL 00 - TELECOMMUNICATIONS PLAN
001TN101	BLDG 001 - LEVEL 01 - TELECOMMUNICATIONS PLAN
001TN102	BLDG 001 - LEVEL 02 - TELECOMMUNICATIONS PLAN
001TN103	BLDG 001 - LEVEL 03 - TELECOMMUNICATIONS PLAN
001TN400a	BLDG 001 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
001TN400b	BLDG 001 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
001TN401	BLDG 001 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
001TN402a	BLDG 001 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
001TN402b	BLDG 001 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
001TN403a	BLDG 001 - LEVEL 03 - ENLARGED TELECOMMUNICATIONS PLANS
001TN403b	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 TELECOMMUNICATIONS PLANS
001TN403c	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 TELECOMMUNICATIONS PLANS
001TN403d	BLDG 001 - LEVEL 03 - ENLARGED PHASE 01 TELECOMMUNICATIONS PLANS
001TN403e	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 TELECOMMUNICATIONS PLANS
001TN403f	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 TELECOMMUNICATIONS PLANS
001TN403g	BLDG 001 - LEVEL 03 - ENLARGED PHASE 02 TELECOMMUNICATIONS PLANS
001TN403h	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 TELECOMMUNICATIONS PLANS

001TN403i	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 TELECOMMUNICATIONS PLANS
001TN403j	BLDG 001 - LEVEL 03 - ENLARGED PHASE 03 TELECOMMUNICATIONS PLANS
001TN403k	BLDG 001 - LEVEL 03 - ENLARGED TELECOMMUNICATIONS PLANS
001TN403l	BLDG 001 - LEVEL 03 - ENLARGED TELECOMMUNICATIONS PLANS
002TN101	BLDG 002 - LEVEL 01 - TELECOMMUNICATIONS PLAN
002TN401	BLDG 002 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
004TN100	BLDG 004 - LEVEL 00 -01 & LEVEL 02 - TELECOMMUNICATIONS PLANS
004TN401	BLDG 004 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
006TN100	BLDG 006 - LEVEL 00 -01 & LEVEL 02 - TELECOMMUNICATIONS PLANS
006TN400	BLDG 006 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
007TN100	BLDG 007 - LEVEL 00 -01 & LEVEL 02 - TELECOMMUNICATIONS PLANS
007TN400	BLDG 007- LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
008TN100	BLDG 008 - LEVEL 00 - TELECOMMUNICATIONS PLAN
008TN101	BLDG 008 - LEVEL 01 - TELECOMMUNICATIONS PLAN
008TN102	BLDG 008 - LEVEL 02 - TELECOMMUNICATIONS PLAN
08ATN100	BLDG 08A - LEVEL 00 - TELECOMMUNICATIONS PLAN
009TN100	BLDG 009 - LEVEL 00 -01 & LEVEL 02 - TELECOMMUNICATIONS PLANS
009TN400	BLDG 009 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
009TN401	BLDG 009 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS

028TN100B	BLDG 028 - LEVEL 00B - TELECOMMUNICATIONS PLAN
028TN100G	BLDG 028 - LEVEL 00G - TELECOMMUNICATIONS PLAN
028TN101	BLDG 028 - LEVEL 01 - TELECOMMUNICATIONS PLAN
028TN102	BLDG 028 - LEVEL 02 - TELECOMMUNICATIONS PLAN
028TN103	BLDG 028 - ATTIC - TELECOMMUNICATIONS PLAN
028TN400G	BLDG 028 - LEVEL 00G - ENLARGED TELECOMMUNICATIONS PLANS
028TN401a	BLDG 028 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
028TN401b	BLDG 028 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
028TN402a	BLDG 028 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
028TN402b	BLDG 028 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
031TN100B	BLDG 031 - LEVEL 00B - TELECOMMUNICATIONS PLAN
031TN100G	BLDG 031 - LEVEL 00G - TELECOMMUNICATIONS PLAN
031TN101	BLDG 031 - LEVEL 01 - TELECOMMUNICATIONS PLAN
031TN102	BLDG 031 - LEVEL 02 - TELECOMMUNICATIONS PLAN
031TN103	BLDG 031 - PENTHOUSE A - TELECOMMUNICATIONS PLAN
031TN400Ba	BLDG 031 - LEVEL 00B - ENLARGED TELECOMMUNICATIONS PLANS
031TN400Bb	BLDG 031 - LEVEL 00B - ENLARGED TELECOMMUNICATIONS PLANS
031TN400Bc	BLDG 031 - LEVEL 00B - ENLARGED TELECOMMUNICATIONS PLANS
031TN400Ga	BLDG 031 - LEVEL 00G - ENLARGED TELECOMMUNICATIONS PLANS
031TN400Gb	BLDG 031 - LEVEL 00G - ENLARGED TELECOMMUNICATIONS PLANS
031TN401	BLDG 031 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
031TN402	BLDG 031 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS

	PLANS
037TN101	BLDG 037 - LEVEL 01 - TELECOMMUNICATIONS PLAN
037TN102	BLDG 037 - LEVEL 02 - TELECOMMUNICATIONS PLAN
037TN402	BLDG 037 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS pants
039TN100	BLDG 039 - LEVEL 00 - TELECOMMUNICATIONS PLAN
039TN101	BLDG 039 - LEVEL 01 - TELECOMMUNICATIONS PLAN
039TN102	BLDG 039 - LEVEL 02 - TELECOMMUNICATIONS PLAN
039TN103	BLDG 039 - LEVEL 03 - TELECOMMUNICATIONS PLAN
039TN400	BLDG 039 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
039TN401a	BLDG 039 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
039TN401b	BLDG 039 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
039TN401c	BLDG 039 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
039TN402a	BLDG 039 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
039TN402b	BLDG 039 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
039TN403	BLDG 039 - LEVEL 03 - ENLARGED TELECOMMUNICATIONS PLANS
044TN100	BLDG 044 - LEVEL 00 - TELECOMMUNICATIONS PLAN
044TN101	BLDG 044 - LEVEL 01 - TELECOMMUNICATIONS PLAN
044TN102	BLDG 044 - LEVEL 02 - TELECOMMUNICATIONS PLAN
044TN103	BLDG 044 - PENTHOUSE - TELECOMMUNICATIONS PLAN
044TN400a	BLDG 044 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
044TN400b	BLDG 044 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
044TN401a	BLDG 044 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
044TN401b	BLDG 044 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS

044TN402a	BLDG 044 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
044TN402b	BLDG 044 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
065TN101	BLDG 065 - LEVEL 01 - TELECOMMUNICATIONS PLAN
065TN102	BLDG 065 - LEVEL 02 - TELECOMMUNICATIONS PLAN
065TN401	BLDG 065 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
066TN100	BLDG 066 - LEVEL 00 - TELECOMMUNICATIONS PLAN
066TN101	BLDG 066 - LEVEL 01 - TELECOMMUNICATIONS PLAN
066TN401	BLDG 066 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
067TN100G	BLDG 067 - LEVEL 00G - TELECOMMUNICATIONS PLAN
067TN101	BLDG 067 - LEVEL 01 - TELECOMMUNICATIONS PLAN
067TN102	BLDG 067 - LEVEL 02 - TELECOMMUNICATIONS PLAN
067TN401a	BLDG 067 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
067TN401b	BLDG 067 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
088TN100	BLDG 088 - LEVEL 00 - TELECOMMUNICATIONS PLAN
088TN101	BLDG 088 - LEVEL 01 - TELECOMMUNICATIONS PLAN
088TN400	BLDG 088 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
088TN401a	BLDG 088 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
088TN401b	BLDG 088 - LEVEL 01 - ENLARGED TELECOMMUNICATIONS PLANS
T58TN100	BLDG T58 - LEVEL 01 & 02 - TELECOMMUNICATIONS PLANS
T59TN101	BLDG T59 - LEVEL 01 - TELECOMMUNICATIONS PLANS
T59TN402	BLDG T59 - LEVEL 02 - ENLARGED TELECOMMUNICATIONS PLANS
T60TN100 `	BLDG T60 - LEVEL 01 & 02 - TELECOMMUNICATIONS PLANS
T61TN101	BLDG T61 - LEVEL 01 & 02 - TELECOMMUNICATIONS

	PLANS
T62TN100	BLDG T62 - LEVEL 00 -01 & 02 - TELECOMMUNICATIONS PLANS
T62TN400	BLDG T62 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
T63TN100	BLDG T63 - LVL 00 - 01 & 02 - TELECOMMUNICATIONS PLANS
T63TN400	BLDG T63 - LEVEL 00 - ENLARGED TELECOMMUNICATIONS PLANS
TN501	TELECOMMUNICATIONS DETAILS
TN502	TELECOMMUNICATIONS DETAILS
TN503	TELECOMMUNICATIONS DETAILS
TN504	TELECOMMUNICATIONS DETAILS
TN505	TELECOMMUNICATIONS DETAILS
TN506	TELECOMMUNICATIONS DETAILS
TN507	TELECOMMUNICATIONS DETAILS
TN508	TELECOMMUNICATIONS DETAILS
TN601	A-SIDE FIBER RISER DIAGRAM
TN602	A-SIDE FIBER RISER DIAGRAM
TN603	A-SIDE FIBER RISER DIAGRAM
TN604	A-SIDE FIBER RISER DIAGRAM
TN605	A-SIDE FIBER RISER DIAGRAM
TN606	B-SIDE FIBER RISER DIAGRAM
TN607	B-SIDE FIBER RISER DIAGRAM
TN608	B-SIDE FIBER RISER DIAGRAM
TN609	B-SIDE FIBER RISER DIAGRAM
TN610	B-SIDE FIBER RISER DIAGRAM
TN701	TELECOMMUNICATIONS SCHEDULE

- - - E N D - - -

SECTION 01 00 00
GENERAL REQUIREMENTS

GENERAL

1.10 SAFETY REQUIREMENTS

A. Refer to section 01 35 26, SAFETY REQUIREMENTS for safety and infection control requirements.

1.11 NOISE PROTECTION

A. Schedule operations that involve the use of equipment with output of high noise levels (i.e., jackhammers, air compressors, and explosive-actuated devices) for after duty working hours. Use of any such equipment must be approved in writing by the Contracting Officer prior to commencement of work.

1.12 GENERAL INTENTION

A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for EHRM INFRASTRUCTURE UPGRADES as required by drawings and specifications. Project scope includes but is not limited to the following infrastructure upgrades: facility fiber throughout the buildings to each Telecommunications Room (TR); provide a redundant fiber run throughout the facility to each TR; provide redundant fiber mains to the demarcation room from the provider point; install needed data drops in quantities as shown on the contract documents; install new electrical outlets throughout the facility in quantities as shown on the contract documents; provide additional power in each TR; upgrade facility power distribution as required; upgrade facility HVAC distribution as required; physical security assessment and upgrades; reconfiguration, expansion, and renovation of existing space (demo, new construction, finishes, cable); data center work – upgrade fiber infrastructure backbone campus-wide within buildings and between buildings; provide diversified path for WAN; and hazardous material abatement. Project scope includes Buildings 1, 2, 4, 6, 7, 8, 9, 28, 31, 37, 39, 44, T-58, T-59, T-60, T-61, T-62, T-63, 65, 66, 67, 88, and visits to the site by Bidders may be made in accordance with what is listed in the solicitation and at the discretion of the Contracting Officer (CO).

B. Offices of Spees Design Build, as Architect Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

C. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

1.13 STATEMENT OF BID ITEM(S)

A. ITEM I, EHRM INFRASTRUCTURE UPGRADES: Work includes all general, safety, and management requirements depicted in the contract documents.

B. ITEM II, GENERAL CONSTRUCTION: Work includes general construction, alterations, and selective demolition depicted in the contract documents.

C. ITEM III, ELECTRICAL WORK: Work includes all labor, materials, equipment, and supervision to perform the required electrical construction work on this project as depicted in the contract documents.

D. ITEM IV, MECHANICAL WORK: Work includes all labor, material, equipment, and supervision to perform the required mechanical construction work on this project depicted in the contract documents.

E. ITEM V, TELECOMMUNICATIONS WORK: Work includes all labor, material, equipment, and supervision to perform the required telecommunications construction work on this project depicted in the contract documents.

F. ITEM VI, STRUCTURAL WORK: Work includes all labor, material, equipment, and supervision to perform the required structural construction work on this project depicted in the contract documents.

G. ITEM VII, SITE AND CIVIL WORK: Work includes all labor, material, equipment, and supervision to perform the required site and civil construction work on this project depicted in the contract documents.

H. ITEM VIII, ENVIRONMENTAL WORK: Work includes all labor, material, equipment, and supervision to perform the required environmental remediation work on this project depicted in the contract documents.

1.14 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

A. Drawings and contract documents may be obtained from the website where the solicitation is posted. Additional copies will be at Contractor's expense.

1.15 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:

1. Physical security of the construction site and installations will meet requirements depicted in the next paragraph "Security Procedures," the VA Design Manual "Physical Security Design Manual for VA Life-Safety Protected Facilities," and any other applicable VA documentation.
2. The Contractor is responsible for determining the security plan that will define both physical and administrative security procedures. Once approved by the VA, these procedures will remain effective for the entire duration of the project.
3. The General Contractor is responsible for assuring that all subcontractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
2. Before starting work the General Contractor shall give one week's notice to the Contracting Officer so that security escort and/or arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
3. No photography of VA premises is allowed without written permission of the Contracting Officer. Patients and staff are not to be photographed at any time.
4. VA reserves the right to close or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Key Control

1. The General Contractor shall provide duplicate keys and lock combinations to the Contracting officers representative (COR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall install all permanent cores at completion of the work. See Section 08 71 00 DOOR HARDWARE and coordinate with the VA COR.

D. Document Control

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".

2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
   a) Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
   b) "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

E. Motor Vehicle Restrictions
   1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.

1.16 OPERATIONS AND STORAGE AREAS (FAR 52.236-10)

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Limited amounts of well-organized and unobtrusive materials and tools may be kept in the construction area interior to the buildings during construction. The VA Medical Center COR may request items be relocated at any points. Contractor designated material storage areas are to

meet all jobsite safety standards and material storage areas are to be returned to their original appearance and function upon completion of work in each work area.

C. Limited amounts of well-organized and unobtrusive materials and tools may be kept in construction exterior lay down areas during construction. The VA Medical Center COR may request items be relocated at any point. Lay down areas are to meet all jobsite safety standards and lay down areas are to be returned to their original appearance and function upon completion of work in each work area.

D. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed. Possible locations and requirements will be discussed and determined by the COR during the post-bid, pre-construction meeting.

E. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

F. Working space and space available for storing materials shall be as determined by the COR.

G. Workers are subject to the rules of the VA Medical Center that are applicable to their conduct.

H. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.

I. Execute work so as to interfere as little as possible with normal functioning of the VA Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that

are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.

1. Do not store materials and equipment in other than assigned areas.
2. Schedule delivery of materials and equipment to immediate construction working or storage areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two workdays. Provide unobstructed access to Medical Center areas required to remain in operation.
3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

J. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the COR or Utility Company involved:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

K. Phasing:

1. The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks.
   a. Normal working hours for this contract will be from 7:00 AM – 4:30 PM (local time), Monday through Friday, except for weekends and established Federal Holidays.
   b. Performing on-site work outside normal working hours will require approval from the Contracting Officer (CO) and the Contracting Officer’s Representative (COR). Requests shall be submitted via email at least 72 hours prior to the requested date and at no additional cost to the Government. Approvals are subject to the availability of on-site staff.

2. To ensure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR 21 calendar days in advance of the proposed date of starting work in ICRA Class I and II work areas, and 28 calendar days in advance of ICRA Class III and IV work areas, as well as critical infrastructure buildings (i.e. Boiler Plant, Chiller Plant, etc.). Arrange such phasing dates to ensure accomplishment of this work in successive phases mutually agreeable to the VA Medical Center Director, COR and Contractor.
3. A/E recommended phasing plans, put together with input from the VA COR and Infection Preventionist and Safety, takes into consideration the complexity of the Medical Center operations and broad scope of buildings impacted by TR/TE renovations and re-cabling efforts. Phasing of TR/TE renovations and individual room Cat 6A re-cabling will be heavily influenced by the ICRA precautions required by the VA, informed by the associated patient risk levels. Critical patient care areas should be considered distinct from non-patient care areas (engineering, admin space, etc.), and the contractor shall regularly consult with the VA on patient care area phasing plans before commencing construction work and upon completion.
4. The following tables outline healthcare and non-healthcare spaces, and recommended phasing constraints:

NON-PATIENT CARE BUILDINGS			
Location	**ICRA Class**	**Construction Hours – TRs**	**Construction Hours – Cat 6a Re-cabling**
Building 2	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 4	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 6	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 7	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 8	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 9	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 28	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 37	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building T-58	See Arch Phasing DWGs	Normal business hours	Nights / Weekends

Building T-59	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building T-60	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building T-61	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building T-62	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building T-63	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 65	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 66	See Arch Phasing DWGs	Normal business hours	Nights / Weekends
Building 67	See Arch Phasing DWGs	Normal business hours	Nights / Weekends

CRITICAL PATIENT HEALTH CARE BUILDINGS			
Location	**ICRA Class**	**Construction Hours – TRs**	**Construction Hours – Cat 6a Re-cabling**
Buildings 1, 31, 39, 44, AND 88	II	*Normal business hours, pending VA approval of Contractor work plan submitted at least 21 calendar days in advance of start of work.	*Contractor shall present work plan to the VA COR 21 calendar days in advance of work for VA pre-approval, showing max rooms that may be re-cabled in a phasing area during 1 full work shift.
	III	*Normal business hours, pending VA approval of Contractor work plan submitted at least 28 calendar days in advance of start of work.	*Contractor shall present work plan at least 28 calendar days in advance of work for VA pre-approval; (3) rooms maximum may be worked on at one time to allow for equipment movement and coordination with VA staff and services. Any variations in room maximum will be on a case-by-case basis and must be approved by the VA COR in advance of construction activities.
	IV	*Normal business hours, pending VA approval of Contractor work plan submitted at least 28 calendar days in advance of start of work.	*Contractor shall present work plan at least 28 calendar days in advance of work for VA pre-approval; (1) room maximum may be worked on at one time to allow for equipment movement and coordination with VA staff and

			services. Any variations in room maximum will be on a case-by-case basis and must be approved by the VA COR in advance of construction activities.

5. Contractor shall provide work plans to VA for final approval. Contractor shall consider the following constraints in phasing:
   a. Contractor shall not commence any planned phase of work without authorization from the COR and an approved outage schedule. It is the Contractor's responsibility to review any appropriate VA phasing forms with VA COR during Preconstruction Meeting. All subsequent planned outages will need to be documented and approved by the COR prior to regulated outages.
   b. The Government may halt work in patient care areas at no cost if work impedes patient care.
   c. The contractor will coordinate with the VA for movement of existing furnishings fixtures and equipment (FFE) from existing or proposed work area spaces prior to work starting in these areas. The Contractor shall be responsible for the movement of all existing FFE from these spaces or back into these spaces, or into alternate locations, upon direction of the VA's COR, once completion of work has occurred in work areas The contractor shall coordinate with the VA on the scheduling and required access clearances and conditions needed to execute work, occurring in planned and agreed upon work areas and their boundaries.
   d. Any TR work that causes excessive noise and/or vibrations shall be coordinated with the VA COR and shall occur only during nights and/or weekends as approved by VA COR.
   e. Contractor is responsible for ensuring continuous network connectivity for patient care spaces. Outages shall not exceed 1 work shift. Cable pulling shall only occur during non-working, non-peak hours, and scheduled weekends as approved by the VA COR, or as noted otherwise in the above tables.
   f. Contractor is responsible for providing a work plan to the VA for approval regarding separation of existing cables and new, and all anticipated demo work.
   g. Contractor to ensure all work in current phase is complete and approved by VA before proceeding to next phase.

h. Taking the above into consideration, the A/E recommends the following phased sequence of construction activities:

PROPOSED PHASING SEQUENCE

This section is a general overview of the sequence of construction activities pertaining to the new ductbank & fiber distribution, MCR renovation, and TR construction and renovation activities. For specific details pertaining to the individual project components, please see the indicated references directly below the general overview:

Overview – Campus Infrastructure

Same-numbered items can be worked on concurrently

1a. Civil duct-banks system installed.

1b. Build new TRs at new locations and/or expand existing TRs as required.

2a. Pull new A/B fiber backbone cables through duct-banks and buildings to existing, expanded, or new TRs.

2b. Install any backbone cables (including CAT 6A & OM4 Fiber) from old TRs to new TRs. *Please see **REFERENCE #2** below**.**

2c. For MCR renovation proposed sequencing, please see **REFERENCE #1** below. Contractor to install fiber ties (2 - 48 strand OS2 cables, one for each ISP) additionally, 1 – 48 strand OS2 cable to connect core routers from old MCR to new MCR. These fiber runs are listed as Umbilical backbone cables on the drawings. Once fiber is tested and certified, Contractor to notify VA. to r installation of new racks bonded to secondary bonding buss bar (not building steel or conduit) in existing/expanded TRs. *Please see **REFERENCE #3** below**.**

2e. Install new racks, cable managers and pathways in new (and expanded/existing) TRs.

2g. In Building TRs, terminate new fiber in new fiber housings in new racks.

2h. In Data Center, terminate new fiber in new fiber housings in new fiber distribution cabinets. (*In cases where MCR isn't available, identify a temporary location to coil/terminate fiber backbone in.)*

3. Test new fiber and get approval (commissioning) from VA COR.

Overview – WAO Replacement and TR Cutovers

(VA to provide ONLY [10] new switches to OIT for TRs to maintaining existing switches in existing racks)

4. VA to relocate Core B switch to new Core B cabinet in MCR. Patch new B side fiber backbones to relocated core switch to each TR to be fed. VA to connect B-side Core Router to A-side Core Router via 48-strand Umbilical cable. c.

5a**.** Fiber in new TRs through B-side:

- New TR/TEs – Provide temporary fiber back feed to existing TR/TE location and patch into existing switch(es), disconnect existing fiber.

5b. Submit cutover plan for VA approval and schedule the installation of new Cat 6a cables on a room/department by room/department basis from new TR racks to existing device WAOs and cutover outlets the same night. *Please see **REFERENCES #4, #5, #6, and #7** below**.**

- Identify any buildings requiring after hours work for VA support (see above tables).
- See phasing drawing sheets and above phasing parameters for specific building and phasing area work requirements.
- End users, services lines, COR, and OIT are notified and ready.
- See **Reference #4 – Work Area Outlet (WAO) Cutover Steps** below for detailed action plan.

6. VA to relocate existing Core A switch to new Core A cabinet in new MCR. Patch new fiber backbones to new or relocated core switch to each TR to be fed.

7. Activate fiber in new TRs through the A-side.

8. Relocate any fiber backbones and complete the Data Center server migration.

9. Once re-cabling is complete, remove all old racks, patch panels, switches, fiber backbones, and data station cabling (unless there are other systems or devices requiring it to stay live).

REFERENCE #1 – MCR PHASING OUTLINE

Phase 1 – Demo and New Construction

*Phasing plan assumes that all furniture, fixtures, and equipment (FFE) will be relocated prior to the start of construction activities in this phase.

Step 1a

1. Build out Side-A and Side-B electrical rooms (B.1 and B.31) that will support the new Data Center.

Step 1b

1. Install temporary barriers and systems needed to meet ICRA / FLS separation from existing spaces to remain.
2. Install temporary double-door

Step 2

1. Install temporary space conditioning for equipment in the existing Data Center

Step 3

1. Demolition of all walls, doors, equipment, MEP & Telecom systems within the Phase #1 area.
    a. **Note –** leave elevated flooring, ramp and step, between column line U & V and between column line 13 & 14 until end of Phase 2 to assist with equipment migrations. Temporary ramp needed between Phase #1 structural floor reinforcement and existing to support equipment migrations.
    b. **Note –** All existing systems outside of Phase #1 area must remain operational during and after demolition.

2. Assess & re-route or modify any existing vertical ductwork, piping, and/or conduit to remain operational. This is necessary to install structural raised floor members.

Step 4

1. Existing coffered structure ceiling and existing flooring required to be cleaned and sealed prior to installation of the structural steel for raised floor system.

Step 5

1. Install structural steel members for raised floor area

Step 6

1. Construct insulated metal stud wall at the interior perimeter of the exterior wall.
2. Construct any interior walls required.

Step 7

1. Install new telecom cabinets: (3) MDAs, (1) HDA, and (12) server cabinets.
2. Install new cable management systems

Step 8

1. Install in-row cooling units (7)

Step 9

1. Install door and containment barriers for cold-aisle rack containment.

Step 10

1. Test and ensure MEP/IT systems are operational

Step 11

1. Install temporary swing rack in Phase 3 area to house Core B router. Migration to occur following completion of Phase 1 and prior to start of construction activities in Phase 2.

***Upon completion of Phase 1, Contractor to notify VA COR to commence with equipment migration from current MCR racks identified in Phase 2 area (permanent racks installed in Phase 1. VA requires 90-days minimum for equipment migrations. Contractor is responsible for schedule coordination of this activity with the site.**

Phase 2 – Demo and New Construction

Step 1

1. Install temporary barriers and systems needed to meet ICRA / FLS separation from existing spaces to remain.

Step 2

1. Install temporary space conditioning for equipment in the existing Data Center

Step 3

1. Demolition of all walls, doors, equipment, MEP & Telecom systems within the Phase #2 area.
    a. **Note –** ensure that all telecom equipment has been relocated by the VA to Phase #1 completed cabinets prior to demo.
    a. **Note –** leave elevated flooring, ramp and step, between column line U & V and between column line 13 & 14 until end of Phase 2 to assist with equipment migrations. Temporary ramp needed between Phase #1 and #2 structural floor reinforcement and existing to support equipment migrations.
    b. **Note –** All existing systems outside of Phase #2 area must remain operational during and after demolition.

2. Assess & re-route or modify any existing vertical ductwork, piping, and/or conduit to remain operational. This is necessary to install structural raised floor members.

Step 4

1. Existing coffered structure ceiling and existing flooring required to be cleaned and sealed prior to installation of the structural steel for raised floor system.

Step 5

1. Install structural steel members for raised floor area

Step 6

1. Construct insulated metal stud wall at the interior perimeter of the exterior wall.
2. Construct any interior walls required.

Step 7

1. Install new telecom cabinets: (3) MDAs, (1) HDA, (1) ISP cabinet (future use), and (3) server cabinets.
2. Install new cable management systems.

Step 8

1. Install in-row cooling units (3)

Step 9

1. Install door and containment barriers for cold-aisle rack containment.

Step 10

1. Test and ensure MEP/IT systems are operational

Step 11

1. Remove separation between Phase 1 cold aisle containment and Phase 2 cold aisle containment.

***Upon completion of Phase 2, Contractor to notify VA COR to commence with equipment migration from current MCR racks identified in Phase 2 area (row to permanent racks installed in Phase 1. VA requires 90-days minimum for equipment migrations. Contractor is responsible for schedule coordination of this activity with the site.**

Phase 3 – Demo and New Construction

Step 1

1. Remove all temporary barriers and systems needed to meet ICRA / FLS separation from existing spaces which are to remain
2. Install new temporary barriers indicated in Phase 3 demolition and new construction areas.

Step 2

1. Demolition of all walls, doors, ramp, ceiling, equipment, MEP & Telecom systems within the Phase #3 area.
    a. **Note –** ensure that all telecom equipment has been relocated by the VA to Phase #2 completed cabinets prior to demo.
2. Assess & re-route or modify any existing vertical ductwork, piping, and/or conduit to remain operational. This is necessary to install structural raised floor members.

Step 3

1. Existing coffered structure ceiling and existing flooring required to be cleaned and sealed prior to installation of the structural steel for raised floor system.

Step 4

1. Install structural steel members for raised floor area

Step 5

1. Construct new steps / ramp.
2. Construct insulated metal stud wall at the interior perimeter of the exterior wall.
3. Construct any interior walls required.
4. Install new door & frame.

Step 6

1. Remove all temporary barriers and systems needed to meet ICRA / FLS separation.

REFERENCE #2 – NEW TRs CONSTRUCTION

1. Task 1
    a. Prepare new TR space
        i. Construct ICRA / phasing barriers
        ii. Demo floors, walls / doors / windows, ceilings, as appropriate.
    b. Build new TR space
        i. Construct new walls and doors; prepare floor (anti-static VCT or coating)
2. Task 2
    a. Install new A-side and B-side panelboards, as appropriate.
    b. Install new lighting and receptacles.
    c. Install physical security equipment.
3. Task 3
    a. Install new cooling (DX / VRV) unit, as appropriate.
4. Task 4
    a. Install new server rack(s), cable management (tray, ladder, etc.)
        i. *If drawings indicate, contractor to install a backbone cable from old TR to new TR.
    b. Install backbone cabling and terminate in rack(s).

REFERENCE #3 – REMODELED EXISTING TR CUTOVER

1. Task 1
    a. Prepare renovation of existing TR space.
        i. Ensure coordination with VA for temporarily disabling existing alarm(s).
        ii. Construct ICRA / phasing barriers.
        iii. *MEP/IT & VA
            1. Coordinate with VA prior to existing equipment movement.
            2. Unmount and protect existing wall-mounted equipment to remain operational during renovation.
        iv. Demo walls / doors, flooring (as necessary), and ceilings.
    b. Finalize layout of new TR space.
        i. Construct all new walls & doors.
        ii. Prepare and install new backboards and anti-static flooring (VCT or coating).

iii. *MEP/IT & VA
    1. Re-mount existing equipment to new backboards.

2. Task 2
    a. Install new HVAC (DX / VRV) system
3. Task 3
    a. Ensure that existing equipment remains powered during A-side electrical infrastructure upgrade / replacement.
    b. Install new A-side electrical infrastructure (panelboard).
    c. Move existing and new equipment to A-side power.
    d. Install new B-side electrical infrastructure (panelboard).
    e. Install new receptacles and lighting.
4. Task 4
    a. Prior to potential existing rack movement, ensure equipment can remain fully operational during temporary positioning.
    b. Unbolt existing rack(s) to accommodate shift within rooms, as necessary.
    c. Place the new (4)-post rack(s) in the TR space.
    d. Install new cable management system reflecting final location of new (4)-post rack installation.
5. Task 5
    a. Install new UPS units in new (4)-post rack(s).
    b. Finalize bonding / grounding to new (4)-post rack(s).

***Contractor to notify VA to commence equipment migration from existing racks to new racks. VA requires 90-days minimum for equipment migrations. Contractor responsible for schedule coordination of this activity with the site.**

REFERENCE #4 – WORK AREA OUTLET (WAO) CUTOVER STEPS

1. Pathways from hallway to room are identified for re-use or installed if new are needed.
2. WAOs are installed (if new), located, and accessible (if existing). Furniture moved, if needed.
3. VA clears room, if needed (patients moved to swing space).
4. VA OIT disconnects equipment from old WAO.
5. Contractor removes old UTP cable from WAO (if re-using existing boxes / conduit). Contractor to remove cable completely from room into corridor and store it in ceiling space for final removal.
6. Contractor install new Cat 6a UTP cable, terminate, and test.
7. Contractor labels UTP, patch panel, and WAO.
8. VA OIT connects patch cables from patch panel to new edge switch.
9. VA OIT validates proper connectivity, PoE, and VLAN assignment at WAO.
10. Room is cleaned, if needed.
11. VA OIT connects equipment to WAO.
12. Room is re-occupied by staff / patient(s).
13. Devices in old TR are patched over to the new TR if on OIT network.
14. Edge switches from old TR are moved to next TR for next TR cutover by VA OIT, if empty.

15. Contractor demos old TR, UTP, wall-mounted 110 blocks, patch panels, and rack (if empty), etc.

REFERENCE #5 – ACCESS CONTROLS

1. New and renovated TR/TEs:
    a. Install 2-door controller in each TR.
    b. Install Cat 6a cable from patch panel to new access control panel and terminate with RJ-45 male end. Test and label cable.
    c. Plug Cat 6a cable into access control panel and test network connection is active.
        i. If panel is not a PoE, then provide battery back-up.
    d. Refer to drawings for equipment installation requirements (card reader w/pin pad, door closer, room motion sensor, RIR REX).

REFERENCE #6 – CAMERAS & CCTVs

1. New & existing cameras (interior / exterior) to be re-cabled with new Cat 6a cabling.
    a. Contractor to install new Cat 6a cable from camera (new or existing location) to new TR, terminate on patch panel, and place a male RJ-45 on end of Cat 6a cable at the camera location. Test Cat 6a cable, coil spare cable at camera end for existing camera locations. New cameras can be plugged into the new Cat 6a cables.
    b. At cutover, Contractor to coordinate with VA OIT and campus police to relocate active electronics supporting CCTV and plug-in new Cat 6a cable to existing cameras.
    c. Label devices and pathways.
    d. Test all devices and provide test results to owner.
    e. Document all work, devices, equipment locations, pathways, j-boxes, and provide as-built documentation to owner in format of their choosing.

REFERENCE #7 – FIRE PROTECTION / ALARM

1. **New MCR will require a connection from the existing head end equipment to the new MCR panel. Existing MCR (renovation) will tie into closest existing fire alarm panel with capacity.**
    a. Install new fire alarm panel in new / remodeled MCR.
    b. Connect backbone cable to nearest existing alarm panel (remodeled MCR), or existing head end equipment (new MCR).
    c. Install devices (smoke detectors, heat risers, etc.) and connect to the new fire alarm panel.
    d. Label devices and pathways.
    e. Test all devices and provide test results to owner.
    f. Document all work, devices, panel locations, pathways, j-boxes, and provide as-built documentation to owner in format of their choosing.

M. All Buildings will be occupied during performance of work, but immediate areas of alterations will be vacated.

1. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated from the construction area by temporary partitions and have walking surfaces, lighting etc. to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.
2. Immediate areas of alterations not mentioned in preceding Subparagraph 1 will be temporarily vacated while alterations are performed.

N. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around any arranged laydown sites coordinated with the COR. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.

O. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:
1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

P. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and

communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY for additional requirements.
2. Contractor shall submit a request to interrupt any such services to the COR, in writing, 14 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption. The contractor is responsible for investigative efforts to capture the scope and scale of the disruption to the requested utility shutdown and fully delineate these impacts within the written request.
3. Contractor shall also provide backup for the utility for which service is disrupted. Backup utilities service must be provided for any utility shutdown request.
4. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
5. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
6. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
7. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

Q. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, shall be removed back to their source. Those which are indicated to

be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.

R. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
   1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times with approval.
   2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.

S. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

1.17 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and a representative of VA Supply Service, of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:
   1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
   2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
   3. Shall note any discrepancies between drawings and existing conditions at site.
   4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is

impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
   1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workers in executing work of this contract.

D. Protection: Provide the following protective measures:
   1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
   2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
   3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.18 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
   1. Reserved items which are to remain property of the Government are identified by attached tags or noted in the contract documents as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
   2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.

3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

1.19 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (FAR 52.236-9)

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workers, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and

affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

1.11 RESTORATION

A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workers to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment.

D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

B. Establish and plainly mark center lines for each building and corner of column lines and/or addition to each existing building, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

D. Contractor shall furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

1. Lines of each building and/or addition.

2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
3. Lines and elevations of sewers and of all outside distribution systems.

E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COR.

F. Upon completion of the work, the Contractor shall furnish the COR one electronic copy and reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

G. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

A. The contractor shall maintain two full-sized sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To ensure compliance, as-built drawings shall be made available for the COR review, as often as requested.

C. Contractor shall deliver two approved completed sets of as-built drawings in the electronic version (scanned PDF) to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.14 WARRANTY MANAGEMENT

A. Warranty Management Plan: Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction in at least 30 days before the planned pre-warranty conference, submit three sets of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesman, or of engineering background, not necessarily familiar with this contract. The term “status” as indicated below must include due date and whether item has been

submitted or was approved. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly invoice for payment. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of the project acceptance and continue for the product warranty period. A joint 4 month and 9-month warranty inspection will be conducted, measured from time of acceptance, by the Contactor and the Contracting Officer. Include in the warranty management plan, but not limited to, the following:

1. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the company of the Contractor, subcontractors, manufacturers or suppliers involved.
2. Furnish with each warranty the name, address and telephone number of each of the guarantor's representatives nearest project location.
3. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers and for all commissioned systems such as fire protection and alarm systems, sprinkler systems and lightning protection systems, etc.
4. A list for each warranted equipment item, feature of construction or system indicating:
    a. Name of item.
    b. Model and serial numbers.
    c. Location where installed.
    d. Name and phone numbers of manufacturers and suppliers.
    e. Name and phone numbers of manufacturers or suppliers.
    f. Names, addresses and phone numbers of sources of spare parts.
    g. Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
    h. Starting point and duration of warranty period.
    i. Summary of maintenance procedures required to continue the warranty in force.
    j. Cross-reference to specific pertinent Operation and Maintenance manuals.
    k. Organizations, names and phone numbers of persons to call for warranty service.
    l. Typical response time and repair time expected for various warranted equipment.

5. The plans for attendance at the 4 and 9-month post construction warranty inspections conducted by the government.
6. Procedure and status of tagging of all equipment covered by extended warranties.
7. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

B. Performance & Payment Bonds: The Performance & Payment Bonds must remain effective throughout the construction period

1. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.
2. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the contractor's expenses, the Contracting Officer will have the right to recoup expenses from the bonding company.
3. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Contracting Officer to proceed against the Contractor.

C. Pre-Warranty Conference: Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/ reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contract will be located within the local service area of the warranted construction, be continuously available and be responsive to Government inquiry on warranty work action and status. This requirement

does not relieve the Contractor of any of its responsibilities in conjunction with other portions of this provision.

D. Contractor's Response to Construction Warranty Service Requirements:

E. Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and back charge the construction warranty payment item established.

1. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.
2. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.
3. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.
4. The "Construction Warranty Service Priority List" is as follows:
   a) <u>Code 1-Life Safety Systems</u>
      1) Fire suppression systems.
      2) Fire alarm system(s).
   b) <u>Code 1-Air Conditioning Systems</u>
      1) Air conditioning leak in part of the building, if causing damage.
      2) Air conditioning system not cooling properly.
   c) <u>Code 1 Doors</u>
      1) Overhead doors not operational, causing a security, fire or safety problem.
      1) Interior, exterior personnel doors or hardware, not functioning properly, causing security, fire or safety problem.
   d) <u>Code 3-Doors</u>
      1) Overhead doors not operational.

2) Interior/exterior personnel doors or hardware not functioning properly.

e) Code 1-Electrical

1) Power failure (entire area or any building operational after 1600 hours).

2) Security lights.

3) Smoke detectors.

f) Code 2-Electrical

1) Power failure (no power to a room or part of building). Receptacle and lights not operational (in a room or part of building).

g) Code 1-Gas

1) Leaks and pipeline breaks.

h) Code 1-Heat

1) Power failure affecting heat.

i) Code 1-Plumbing

1) Hot water heater failure.

2) Leaking water supply pipes

j) Code 3-Interior

1) Floors damaged.

2) Paint chipping or peeling.

3) Casework damaged.

k) Code 1-Roof Leaks

1) Damage to property is occurring.

l) Code 2-Water (Exterior)

1) No water to facility.

m) Code 3

1) All work not listed above.

F. Warranty Tags: At the time of installation, tag each warranted item with a durable, oil and water-resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Warranty Tags
Type of product/material
Model number
Serial number
Contract number
Warranty period from/to
Inspector’s signature
Construction Contractor
Address
Telephone number
Warranty Contact
Address
Telephone number
Warranty response time priority code

1.15 USE OF ROADWAYS

A. For hauling, use only established public roads and roads on the VA Medical Center property and, when authorized by the COR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed and restoration performed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.16 TEMPORARY USE OF EXISTING ELEVATORS

A. Contractor will not be allowed the use of existing elevators. Outside type hoist shall be used by Contractor for transporting materials and equipment.

B. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the COR for use of elevators. The COR will ascertain that elevators are in proper condition. Contractor may use one elevator in each building, which shall be coordinated with the COR prior to Contractor use. Temporary elevator wall protection pads and elevator floor matting is to be provided by the Contractor and installed in the elevator for the entire duration of Contractor use. Any damage to the elevator as a result of Contractor construction activities is to be repaired at the expense of the Contractor.

2. Contractor covers and provides maximum protection of following elevator components:
   a) Entrance jambs, heads soffits and threshold plates.
   b) Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
   c) Finish flooring.
3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes at the contractors expense.

1.17 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by COR, provide suitable dry closets where directed. Keep such places clean and free from flies and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.
   1. *Contractor may have for use of Contractor's workers, such toilet accommodations as may be assigned to Contractor by Medical Center. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workers. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.18 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

B. The Contractor, at Contractor's expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.

C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.

D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

1. Obtain heat by connecting to Medical Center heating distribution system.

E. Electricity (for Construction and Testing): Furnish all temporary electric services.

1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR discretion) of use of water from Medical Center's system.

G. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished and paid by the Contractor at Contractor's expense.

1.19 TESTS

A. As per specification section 23 05 93 the contractor shall provide a written testing and commissioning plan complete with component level, equipment level, sub-system level and system level breakdowns. The plan will provide a schedule and a written sequence of what will be tested, how and what the expected outcome will be. This document will be submitted for approval prior to commencing work. The contractor shall document the results of the approved plan and submit for approval with the as built documentation.

B. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

C. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

D. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire system which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.

E. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably period of time during which operating and environmental conditions remain reasonably constant and are typical of the design conditions.

F. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.20 INSTRUCTIONS

A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.

B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and subassembly components. Manuals shall include an index covering all component parts clearly crossreferenced to diagrams and illustrations. Illustrations shall include "exploded" views

showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed training to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COR for review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.21 GOVERNMENT-FURNISHED PROPERTY

A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.

B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.

C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.

D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.

1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.

E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stubup shall be furnished and installed by the contractor at no additional cost to the Government.

F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.

G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.22 RELOCATED EQUIPMENT

A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment indicated or otherwise shown to be relocated by the Contractor.

B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.

C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

E. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of equipment, required to be relocated.

F. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.23 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT

A. Contractor shall utilize a temporary Conex box (or similar) to be staged in the area designated by the VA COR for storage of certain materials and equipment by Department of Veterans Affairs.
   1. Provide such space with adequate light, ventilation and heat in season and lock for adequate security. Contractor shall also install and connect portion of nearest specified fire protection system including all apparatus for instant use to provide water for adequate fire protection of storage space.
   2. Storage space shall be turned over to Contracting Officer ninety days prior to Completion Date of the buildings involved.
   3. Forward two sets of drawings to Contracting Officer through the COR 120 days prior to Completion Date of building; drawings shall indicate those areas which will be made available to Department of Veterans Affairs for temporary storage.
   4. All cost for utility services for such storage space shall be borne by Contractor until entire building is turned over for occupancy.

B. "Completion Date" shall mean that date as established by Contracting Officer upon which Contractor will turn over entire project or portions thereof to the Government.

1.24 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the COR.

D. Detail Drawing of construction sign showing required legend and other characteristics of sign is shown on the drawings.

1.25 SAFETY SIGN

A. Provide a Safety Sign where directed by COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.

C. Maintain sign and remove it when directed by COR.

D. Drawing details in VA Signage Design Manual, Section 11 Specialty Signs (found on VA TIL) show required legend and other characteristics of sign and are shown on the drawings.

E. Post the number of accident-free days on a daily basis.

Number of photographs	
Estimated Cost	No. of Photographs
Up to $250,000	50 to 100
Up to $500,000	100 to 150
Up to $1,000,000	150 to 200
Up to $2,000,000	200 to 250
Up to $5,000,000	250 to 300
Up to $10,000,000	300 to 400
More than $10,000,000	400 to 500

1.26 FINAL CONSTRUCTION DIGITAL IMAGES

A. Photographs shall be taken upon completion of work, including landscaping. They shall be taken on a clear sunny day or with appropriate interior lighting to obtain sufficient detail to show depth and to provide clear, sharp pictures. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.

1.27 HISTORIC PRESERVATION

A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

1.28 SEVERE STORM PLAN

A. In the event of a severe storm warning, the Contractor must comply with the applicable Storm Plan and:

1. Secure outside equipment and materials and place materials that could be damaged in protected areas.
2. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
3. Ensure that temporary erosion controls are adequate.

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SECTION 01 32 16.15
PROJECT SCHEDULES
(SMALL PROJECTS – DESIGN/BID/BUILD)

PART 1- GENERAL

1.1 DESCRIPTION:

A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COTR).

B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.

C. The Contractor’s representative shall have the option of developing the project schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.3 of this specification will apply.

1.3 CONTRACTOR'S CONSULTANT:

A. The Contractor shall submit a qualification proposal to the COTR, within 10 days of bid acceptance. The qualification proposal shall include:

1. The name and address of the proposed consultant.
2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.

B. The Contracting Officer has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant

within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three electronic copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; an electronic copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look-ahead report. The COR shall identify the five different report formats that the contractor shall provide.

B. The contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.

C. The VA will report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports when requested by the Contracting Officer's representative, to correct errors which affect the payment and schedule for the project.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; a blue-line electronic copy of the interim schedule in the previously approved CPM schedule program. The submittal shall also include an electronic copy of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer

identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. **The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

B. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
   1. Notify the Contractor concerning his actions, opinions, and objections.
   2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

C. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.

1.6 WORK ACTIVITY/EVENT COST DATA

A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled

to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION).

C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.

D. The Contractor shall cost load work activities/events for all BID ITEMS including ASBESTOS ABATEMENT. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:

1. Show activities/events as:
   a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
   b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area,

floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.

3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COTR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.
4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.

B. The Contractor shall submit the following supporting data in addition to the project schedule:
   1. The appropriate project calendar including working days and holidays.
   2. The planned number of shifts per day.
   3. The number of hours per shift.

   Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.

C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COTR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COTR's approval of the Project Schedule.

D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a or the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will

be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 70 Without NAS-CPM or Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.

B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

1.9 PAYMENT AND PROGRESS REPORTING

A. Monthly schedule update meetings will be held on dates mutually agreed to by the COTR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COTR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
5. Completion percentage for all completed and partially completed activities/events.
6. Logic and duration revisions required by this section of the specifications.
7. Activity/event duration and percent complete shall be updated independently.

B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.

C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and Resident Engineer for the contract change(s). When there is

a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the Resident Engineer. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the Resident Engineer within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
3. Reschedule the work in conformance with the specification requirements.

B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COTR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
   1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
   2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
   3. The schedule does not represent the actual prosecution and progress of the project.
   4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.

B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.

C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.

D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 – 4 (Changes, and will be based on

the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.

E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COTR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.

B. Actual delays in activities/events which, according to the computer- produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 – 4 (Changes). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

D. All delays due to non-work activities/events such as RFI’s, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. This specification defines the general requirements and procedures for submittals. A submittal is information submitted for VA review to establish compliance with the contract documents.

B. Detailed submittal requirements are found in the technical sections of the contract specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective technical specifications at no additional cost to the government.

C. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

1.2 DEFINITIONS

A. Preconstruction Submittals: Submittals which are required prior to issuing contract notice to proceed or starting construction. For example, Certificates of insurance; Surety bonds; Site-specific safety plan; Construction progress schedule; Schedule of values; Submittal register; List of proposed subcontractors.

B. Shop Drawings: Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be integrated and coordinated.

C. Product Data: Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures, which describe and illustrate size, physical appearance, and other characteristics of materials, systems, or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.

D. Samples: Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed to establish standards by which the ensuing work can be judged.

E. Design Data: Calculations, mix designs, analyses, or other data pertaining to a part of work.

F. Test Reports: Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

G. Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.

H. Manufacturer's Instructions: Pre-printed material describing installation of a product, system, or material, including special notices and MSDS concerning impedances, hazards, and safety precautions.

I. Manufacturer's Field Reports: Documentation of the testing and verification actions taken by manufacturer's representative at the job site on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must indicate whether the material, product, or system has passed or failed the test.

J. Operation and Maintenance Data: Manufacturer data that is required to operate, maintain, troubleshoot, and repair equipment, including manufacturer's help, parts list, and product line documentation. This data shall be incorporated in an operations and maintenance manual.

K. Closeout Submittals: Documentation necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a phase of construction on a multi-phase contract.

1.3 SUBMITTAL REGISTER

A. The submittal register will list items of equipment and materials for which the contract documents denote, but which have been omitted from the submittal register.

B. The submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.

C. The VA will provide a blank submittal register in electronic format. Thereafter, the Contractor shall fill in the blank register with the required submittals as documented in the project spec. The Contractor shall track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the VA.

D. Blank digital register provided for Contractor use below:

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D. The Contractor shall update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by Contracting Officer.

E. The Contractor shall submit formal monthly updates to the submittal register in electronic format. Each monthly update shall document actual submission and approval dates for each submittal.

1.4 SUBMITTAL SCHEDULING

A. Submittals are to be scheduled, submitted, reviewed, and approved prior to the acquisition of the material or equipment.

B. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for potential resubmittal.

C. No delay costs or time extensions will be allowed for time lost in late submittals or resubmittals.

D. All submittals are required to be approved prior to the start of the specified work activity.

1.5 SUBMITTAL PREPARATION

A. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

B. Collect required data for each specific material, product, unit of work, or system into a single submittal. Prominently mark choices, options, and portions applicable to the submittal. Partial submittals will not be accepted for expedition of construction effort. Submittal will be returned without review if incomplete.

C. If available product data is incomplete, provide Contractor-prepared documentation to supplement product data and satisfy submittal requirements.

D. All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned without review.

E. Provide a transmittal form for each submittal with the following information:

1. Project title, location and number.

2. Construction contract number.
3. Date of the drawings and revisions.
4. Name, address, and telephone number of subcontractor, supplier, manufacturer, and any other subcontractor associated with the submittal.
5. List paragraph number of the specification section and sheet number of the contract drawings by which the submittal is required.
6. When a resubmission, add alphabetic suffix on submittal description. For example, submittal 18 would become 18A, to indicate resubmission.
7. Product identification and location in project.

F. The Contractor is responsible for reviewing and certifying that all submittals are in compliance with contract requirements before submitting for VA review. Proposed deviations from the contract requirements are to be clearly identified. All deviations submitted must include a side by side comparison of item being proposed against item specified. Failure to point out deviations will result in the VA requiring removal and replacement of such work at the Contractor's expense.

G. Stamp, sign, and date each submittal transmittal form indicating action taken.

H. Stamp used by the Contractor on the submittal transmittal form to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR
(Firm Name)
_____Approved
_____Approved with corrections as noted on submittal data and/or attached sheets(s)
SIGNATURE: _____
TITLE: _____
DATE: _____

1.6 SUBMITTAL FORMAT AND TRANSMISSION

A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer.

B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents.

C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines are required.

D. All documents (submittals) should be sent through FTP File Sharing system.~~E-mail electronic submittal documents smaller than 5MB in size to e-mail addresses as directed by the Contracting Officer.~~

E. Provide electronic documents over 5MB through an electronic FTP file sharing system. Confirm that the electronic FTP file sharing system can be accessed from the VA computer network. The Contractor is responsible for setting up, providing, and maintaining the electronic FTP file sharing system for the construction contract period of performance.~~Provide electronic documents over 5MB through an electronic FTP file sharing system. Confirm that the electronic FTP file sharing system can be accessed from the VA computer network. The Contractor is responsible for setting up, providing, and maintaining the electronic FTP file sharing system for the construction contract period of performance.~~

F. Provide hard copies of submittals when requested by the Contracting Officer. Up to 3 additional hard copies of any submittal may be requested at the discretion of the Contracting Officer, at no additional cost to the VA.

1.7 SAMPLES

A. Submit two sets of physical samples showing range of variation, for each required item.

B. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified.

C. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

D. Before submitting samples, the Contractor is to ensure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

E. The VA reserves the right to disapprove any material or equipment which previously has proven unsatisfactory in service.

F. Physical samples supplied maybe requested back for use in the project after reviewed and approved.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

B. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.9 TEST REPORTS

Resident Engineer may require specific test after work has been installed or completed which could require contractor to repair test area at no additional cost to contract.

1.10 VA REVIEW OF SUBMITTALS AND RFIS

A. The VA will review all submittals for compliance with the technical requirements of the contract documents. The Architect-Engineer for this project will assist the VA in reviewing all submittals and determining contractual compliance. Review will be only for conformance with the applicable codes, standards and contract requirements.

B. Period of review for submittals begins when the VA Resident Engineer receives submittal from the Contractor.

C. Period of review for each resubmittal is the same as for initial submittal.

D. VA review period is 15 business days for submittals.

E. VA review period is 10 business days for RFIs.

F. The VA will return submittals to the Contractor with the following notations:

1. "Approved": authorizes the Contractor to proceed with the work covered.
2. "Approved as noted": authorizes the Contractor to proceed with the work covered provided the Contractor incorporates the noted comments and makes the noted corrections.
3. "Disapproved, revise and resubmit": indicates noncompliance with the contract requirements or that submittal is incomplete. Resubmit with appropriate changes and corrections. No work shall proceed for this item until resubmittal is approved.
4. "Not reviewed": indicates submittal does not have evidence of being reviewed and approved by Contractor or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals after taking appropriate action.

1.11 APPROVED SUBMITTALS

A. The VA approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.

B. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

C. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

D. Retain a copy of all approved submittals at project site, including approved samples.

1.12 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

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SECTION 01 35 26
SAFETY REQUIREMENTS

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SECTION 01 35 26
SAFETY REQUIREMENTS

1.1 APPLICABLE PUBLICATIONS:

A. Latest publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

B. American Society of Safety Professionals (ASSP):

A10.1-2011 .....Pre-Project & Pre-Task Safety and Health Planning

A10.34-2012 .....Protection of the Public on or Adjacent to Construction Sites

A10.38-2013 .....Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations

Z359.0-2012.....Definitions and Nomenclature Used for Fall Protection and Fall Arrest

Z359.1-2016.....The Fall Protection Code

C. American Society for Testing and Materials (ASTM):

E84-2013.....Surface Burning Characteristics of Building Materials

D. The Facilities Guidelines Institute (FGI):

FGI Guidelines-2010Guidelines for Design and Construction of Healthcare Facilities

E. National Fire Protection Association (NFPA):

10-2018.....Standard for Portable Fire Extinguishers

30-2018.....Flammable and Combustible Liquids Code

51B-2019 .....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

70-2020.....National Electrical Code

70B-2019 .....Recommended Practice for Electrical Equipment Maintenance

70E-2018 .....Standard for Electrical Safety in the Workplace

241-2019.....Standard for Safeguarding Construction, Alteration, and Demolition Operations

703-2024.....Standard for Fire Retardant–Treated Wood and Fire-Retardant Coatings for Building Materials

F. The Joint Commission (TJC)

TJC Manual .....Comprehensive Accreditation and Certification Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20 .....Standards for Protection Against Radiation

H. U.S. Occupational Safety and Health Administration (OSHA):

29 CFR 1904 .....Reporting and Recording Injuries & Illnesses

29 CFR 1910 .....Safety and Health Regulations for General Industry

29 CFR 1926 .....Safety and Health Regulations for Construction Industry

CPL 2-0.124.....Multi-Employer Citation Policy

I. US Army Corps of Engineers Safety and Occupational Health (SOH) Requirements Publication No. EM 385-1-1, 2024 edition

1.2 DEFINITIONS:

A. Critical Lift. A lift with the hoisted load exceeding 75% of the crane's maximum capacity; lifts made out of the view of the operator (blind picks); lifts involving two or more cranes; personnel being hoisted; and special hazards such as lifts over occupied facilities, loads lifted close to power-lines, and lifts in high winds or where other adverse environmental conditions exist; and any lift which the crane operator believes is critical.

B. OSHA "Competent Person" (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).

C. Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA's Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

D. Competent Person, Cranes and Rigging.

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures regarding such hazards.

E. Competent Person, Excavation/Trenching.

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

F. Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSE/SAFE Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

G. Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented and include experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented, minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

H. Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

I. High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

J. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.

K. Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the requirements of EM 385-1-1 Appendix Q, and ASSE/SAFE Z359.0, with a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

L. USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

High Visibility Accident. Any mishap which may generate publicity or high visibility.

M. Mishap: Mishap in this specification is defined according to the EM 385-1-1. A mishap is any unplanned, undesired event that occurs during the course of work being performed. This includes accidents, incidents, and near misses.

N. Mishap Criticality Categories

1. No impact/Near-Miss – near miss incidents that shall be investigated and reported to the VA within 24 hours.

2. Minor incident/impact – incidents that require first aid or result in minor equipment damage (less than $5000). These incidents must be investigated and reported to the VA within 24 hours.

3. Moderate incident/impact – Any work-related injury or illness that results in any of the following. These incidents must be investigated and are required to be reported to the VA within 2 hours.

    a. Days away from work (any time lost after day of injury/illness onset);

    b. Restricted work;

    c. Transfer to another job;

    d. Medical treatment beyond first aid;

    e. Loss of consciousness;

f. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (5) above or,

g. any incident that leads to major equipment damage (greater than $5000).

4. Major incident/impact – Any mishap that leads to fatalities, hospitalizations, amputations, and losses of an eye as a result of contractors' activities. Or any incident which leads to major property damage (greater than $20,000) and/or may generate publicity or high visibility. These incidents must be investigated and are required to be reported to the VA as soon as practical, but not later than 2 hours after the incident.

O. Load Handling Equipment (LHE)
LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

P. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by physician or registered personnel.

1.3 SUBMITTAL REQUIRMENTS:

A. Government approval or concurrence is required for submittals with a "G" designation; submittals not having a "G" designation are submitted for information only.

B. Preconstruction Submittals

1. Accident Prevention Plan (APP); G

C. Reports

1. Monthly Contractor Health Safety and Environmental (HS&E) Performance Report; G

2. Notifications and Reports;

3. Mishap Reports;

4. Near-Miss Reports;

5. LHE Inspection Reports

6. Monthly Exposure Hour Reports;

D. Work Plans

1. Standard Lift Plan; G
2. Critical Lift Plan; G
3. Activity Hazard Analysis (AHA); G
4. Confined Space Entry Permit
5. Hot Work Permit
6. Radiography Operation Planning Work Sheet; G
7. Portable Gauge Operations Planning Worksheet; G

E. Certificates

1. Contractor Safety Self-Evaluation Checklist
2. Crane Operators/Riggers Certifications; G
3. Certificate of Compliance
4. Mobile Cranes Inspection Certificate
5. License Certificates
6. Machinery & Mechanized Equipment Certification Form

1.4 REGULATORY REQUIREMENTS:

A. In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSP A10.34, and all applicable federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the Resident Engineer or Contracting Officer Representative.

1.5 ACCIDENT PREVENTION PLAN (APP):

A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that Mishap prevention responsibilities are being carried out.

B. The APP shall be prepared as follows:

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract. Specifically articulating the safety requirements found within these VA contract safety specifications and the latest version of the United States Army Corps of Engineers – Safety and Occupational Health (SOH) Requirements - EM 385-1-1 Manual. Model language and format can be found in Appendix A of the EM 385-1-1 Manual

2. Address both the Prime Contractors and the subcontractors work operations.

3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.

4. Address all the elements/sub-elements and in order as follows:

a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:

1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);

2) Plan approver (company/corporate officers authorized to obligate the company);

3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional).

Provide concurrence of other applicable corporate and project personnel (Contractor).

b. **BACKGROUND INFORMATION**. List the following:

1) Contractor;

2) Contract number;

3) Project name;

4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).

c. **STATEMENT OF SAFETY AND HEALTH POLICY**. Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided. The Statement of Safety and Health Policy must be signed by a company executive.

d. **RESPONSIBILITIES AND LINES OF AUTHORITIES**. Provide the following:

1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;

2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.

3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA or EM 385-1-1 Competent/Qualified Person(s) requirements must be attached.;

4) Requirements that no work shall be performed unless a designated competent person is present on the job site;

5) Requirements for pre-task Activity Hazard Analysis (AHAs);

6) Lines of authority;

7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;

e. **SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:

1) Identification of subcontractors and suppliers (if known);

2) Safety responsibilities of subcontractors and suppliers.

f. **TRAINING.**

1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.

2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc….) and any requirements for periodic retraining/recertification are required.

3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.

4) OSHA 10-hour Construction Outreach training within the past five years is required for all workers on site and the OSHA 30-hour Construction Outreach training within the past five years is required for Trade Competent Persons (CPs)

g. **SAFETY AND HEALTH INSPECTIONS.**

1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., “Site Safety and Health CP”), proof of inspector’s training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.

2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

h. **MISHAP INVESTIGATION & REPORTING.**

1) The APP shall include identify person(s) responsible to provide the following to the Contracting Officer Representative:

1. Monthly HS&E Performance Report (Exposure Hours Data);
2. Mishap investigation reports;
3. Project site injury and illness logs;
4. Near-Miss reports;

i. **PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA and/or EM 385-1-1 compliance programs, the Contractor shall address all applicable occupational, patient, and public safety risks in site-specific compliance and accident prevention plans. These Plans shall include but are not limited to procedures for addressing the risks associated with the following:

1) Emergency response;

2) Contingency for severe weather;

3) Fire Prevention;

4) Medical Support;

5) Posting of emergency telephone numbers;

6) Prevention of alcohol and drug abuse;

7) Site sanitation (housekeeping, drinking water, toilets);

8) Night operations and lighting;

9) Hazard communication program;

10) Welding/Cutting “Hot” work;

11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);

12) General Electrical Safety;

13) Hazardous energy control (LOTO);

14) Site-Specific Fall Protection & Prevention;

15) Excavation/trenching;

16) Asbestos abatement;

17) Lead abatement;

18) Crane Critical lift;

19) Respiratory protection;

20) Health hazard control program;

21) Radiation Safety Program;

22) Abrasive blasting;

23) Heat/Cold Stress Monitoring;

24) Crystalline Silica Monitoring (Assessment);

25) Demolition plan (to include engineering survey);

26) Formwork and shoring erection and removal;

27) Pre-Cast Concrete;

28) Public (Mandatory compliance with ANSI/ASSP A10.34-2012);

29) Sub-contractor or cross-trade coordination;

C. Submit the APP to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction safety conference for acceptance. Work cannot proceed without an accepted APP.

D. Once accepted by the Contracting Officer Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer in accordance with FAR Clause 52.236-13, *Accident Prevention*, until the matter has been rectified.

E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Resident Engineer, Contracting Officer Representative or Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Resident Engineering Office and Contracting Officer within 2 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions to safeguard onsite personnel, visitors, the public and the environment.

1.6 ACTIVITY HAZARD ANALYSES (AHAS):

A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)

B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

C. Work shall not begin until the AHA for the work activity has been accepted by the Resident Engineer, Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA, EM 385-1-1, or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.

2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).

a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.

b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.

3. Submit AHAs to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least weekly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative or Government Designated Authority for review for compliance.

1.7 PRECONSTRUCTION SAFETY CONFERENCE:

A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the pre-construction safety conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.

B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the

performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

1.8 SAFETY MEETINGS:

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance.

1.9 “SITE SAFETY AND HEALTH OFFICER” (SSHO) AND “COMPETENT PERSON” (CP):

A. The Prime Contractor shall provide a Safety oversight team that includes a minimum of one (1) person at each project site, for each shift, to function as the Site Safety and Health Officer (SSHO). The Prime Contractor shall provide a minimum of one “Full-Time” SSHO at each project site, for each shift (with no other duties) that holds as current, a professional safety certification with at least 3 years of dedicated construction safety related experience. The SSHO shall ensure that the requirements of the VA and of 29 CFR 1926.16 are met for the project. The SSHO must be at the work site at all times, during construction activities, to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. If the SSHO is off-site for a period longer than 8 hours, or one shift, and not exceeding 40 hours, or 5 shifts, a pre-approved Alternate Safety Officer shall be provided and shall fulfill the same roles and responsibilities as the primary SSHO. The Alternate Safety Officer shall have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs. When the SSHO is temporarily (not to exceed 8 hours) off-site, a Designated Representative (DR) from the Prime Contractors’ staff, as identified in the AHA may be used in lieu of an Alternate Safety Officer and shall be on the project site, at all times, when work is being performed. Note that the DR is a collateral duty safety position, with safety duties

in addition to their full-time occupation. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.

B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations). However, the SSHO has be a separate qualified individual from the Prime Contractor's Superintendent and/or Quality Control Manager with duties only as the SSHO

D. The SSHO or an equally qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: *Superintendence by the Contractor*. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.

E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

1.10 TRAINING:

A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project.

B. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety Outreach class within the past five (5) years and:

1. Seven (7) years of construction industry safety related experience.

2. OR have a safety and health degree from an accredited university or college and five (5) years of construction industry safety related experience

3. OR hold as current, a Certified Safety Professional (CSP) or a Construction Health and Safety Technician (CHST) certification and five (3) years of construction industry safety related experience.

C. The Alternate Safety Officer shall meet, at a minimum, the requirements of EM 385-1-1 Section 1 and have five (5) years of construction industry safety experience If the SSHO does not have a current certification, certification must be obtained within 90 days, maximum, of contract award.

D. All designated CPs shall have completed the OSHA 30-hour Construction Safety course and/or EM 385-1-1 40-hour training within the past 5 years. In addition, all CPs with high hazard work operations (such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations) shall have a specialized formal course in the hazard recognition and control associated with those high hazard work operations. Documented “repeat” deficiencies in the execution of safety requirements will require retaking the requisite formal course.

E. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course within the past 5 years and any necessary safety training to be able to identify hazards within their work environment.

F. Submit training records associated with the above training requirements to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction safety conference for acceptance.

G. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Resident Engineer that individuals have undergone contractor’s safety briefing.

H. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

1.11 INSPECTIONS:

A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection with a written report of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work areas. Coordinate with, and report findings and corrective actions weekly to the Contracting Officer Representative.

B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT shall be one that is not a part of the immediate site project team. The individual can be a corporate safety professional or independently contracted who is not an immediate member of the construction project site team. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.

1. Results of the inspection will be documented with tracking of the identified hazards to abatement.

2. The Contracting Officer Representative will be notified immediately prior to start of the inspection and invited to accompany the inspection.

3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.

4. A report of the inspection findings with status of abatement will be provided to the Contracting Officer Representative within one week of the onsite inspection.

1.12 MISHAPS, OSHA 300 LOGS, AND EXPOSURE-HOURS:

A. The prime contractor shall establish and maintain a Near-Miss and Mishap reporting, recordkeeping, and analysis system to track and analyze all injuries and illnesses, high visibility incidents, and accidental property damage (both government and contractor) that occur on site. Notify and provide an initial report to the Contracting Officer as soon as practical, but no more than two hours after any Moderate or Major Mishap, High Visibility Incidents, or any weight handling and hoisting equipment mishap. No Impact/Near-Miss and Minor Mishaps shall be reported within 24 hours or as soon as practical. Within the notification the sender shall include

contractor name; contract title; type of contract; name of activity, installation or location where mishap occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of mishap (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the Mishap site until the Contracting Officer Representative determines whether a government investigation will be conducted.

B. Conduct a mishap investigation for all Mishaps including mishaps resulting in at least $20,000 in damages without injury, to establish the root cause(s) of the mishap. The Mishap investigation shall include images, 5 whys, the injured person's firsthand account, any witness accounts, methods of procedures, related AHA to the task, and corrective action plan signed by the president, vice president, or appropriate corporate-level leadership identified in the company's org chart for the project. Additionally, complete the VA Form 2162 (or equivalent) and provide the report to the Contracting Officer Representative within 7 calendar days of the accident. The Contracting Officer Representative will provide copies of any required or special forms.

C. A summation of all exposure-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative no later than the 10th day of the following month.

D. A summation of all Minor, Moderate, and Major incidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative upon request.

1.13 PERSONAL PROTECTIVE EQUIPMENT (PPE):

A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.

B. Any PPE above and beyond the Mandatory PPE identified below and determined by the Contracting Officer or their Representative to be necessary in the performance of the Governments duties relative to this contract, shall be provided to the Government upon written notification by the Contracting Officer and at no additional expense to the Government. All PPE

provided to the Government shall also be accompanied by any relevant or required training necessary to ensure its proper use.

C. Mandatory Minimum PPE includes:

1. Hard Hats – unless written authorization is given by the Contracting Officer Representative in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA and/or EM 385-1-1 regulations.

2. Safety glasses - unless written authorization is given by the Contracting Officer Representative in circumstances of no eye hazards, appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.

3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer in circumstances of no foot hazards.

4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

5. High-visibility Safety Apparel – appropriate brightly colored clothing that feature some type of reflective material on them, such as safety vests, shall be worn by personnel or visitors on construction sites.

1.14 PRE-CONSTRUCTION RISK ASSESSMENT

A. Control of all construction-associated hazards that affect VA medical facilities, their occupants, services and mission-essential functions and capabilities is critical in all medical center facilities. VHA Pre-Construction Risk Assessments (PCRAs) for construction, renovation and maintenance projects are included with this contract solicitation with required mitigations of identified hazards. VHA-PCRAs will be re-validated and updated as needed based on but not limited to changes from original designs, affected individuals, areas/locations, scope, contractor means and methods, safety requirements, phasing, contractor competencies and capabilities.

B. Infection Prevention and Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within

ventilation-controlled areas that minimize the flow of airborne particles into patient areas. A detailed analysis of potential risks for infectious disease transmission affecting the care, treatment or services of patients or residents has been conducted. VHA Infection Control Risk Assessments (ICRAs) are included with this contract solicitation with required mitigation actions/activities. VHA-ICRAs will be re-validated and updated as needed based on changes in original designs, affected individuals, area(s) or location(s), scope, contractor means and methods, infection prevention and control requirements, differing site conditions, phasing, contractor competencies and capabilities, and infectious disease outbreaks.

C. For work occurring at a VA medical facility, coordinate with the facility Safety Manager/Officer, as several aspects of this section directly relate to infection control risk assessments required in or adjacent to construction affecting occupied buildings accredited by The Joint Commission.

D. Products and Materials:

1. Sheet Plastic: Fire retardant polyethylene, 6-mil thickness meeting local fire codes
2. Barrier Doors: Self Closing One-hour fire-rated solid core wood in steel frame, painted
3. Dust proof one-hour fire-rated drywall
4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.
5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose
6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches
7. Disinfectant: EPA-registered, Hospital-approved disinfectant or equivalent product
8. Portable Ceiling Access Module

1.15 DUST CONTROL

A. Contractor shall verify that dust will not be introduced into the facility through intake vents or building openings. HEPA filtration on intake vents is required where dust may be introduced.

B. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary.

C. All cutting, drilling, grinding, sanding, or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

1.16 TUBERCULOSIS SCREENING

A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site. NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.

1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.

2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.

3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

1.17 FIRE SAFETY

A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

C. For work occurring at a VA medical facility, coordinate with the facility Safety Manager/Officer, as several aspects of this section directly relate to interim life safety measures required in or adjacent to construction affecting occupied buildings accredited by The Joint Commission.

D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

E. Temporary Construction Partitions:

1. Install and maintain temporary construction partitions to provide smoke-tight separations between the construction areas and adjoining areas. Construct partitions of gypsum board or fire-retardant treated plywood (fire-retardant treated in accordance with NFPA 703) on both sides of fire-retardant treated wood framing or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.

2. Install one-hour fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.

3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with the Contracting Officer Representative.

H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the Contracting Officer Representative.

I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.

J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.

M. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with the Contracting Officer Representative. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer.

N. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with the Contracting Officer Representative.

O. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with the Facility Safety Office. Obtain permits from the Resident Engineer and Facility Safety Office at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

P. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to the Contracting Officer Representative.

Q. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.

R. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

S. If required, submit documentation to the Resident Engineer that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.18 ELECTRICAL

A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J – General Environmental Controls, 29 CFR Part 1910 Subpart S – Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.

B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.

C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance when achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative, with approval of the Medical Center Director, will make the determination if the circumstances would meet the exception outlined above. An AHA and permit specific to energized work activities will be developed, reviewed, and accepted by the VA prior to the start of that activity.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.

2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.

3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Contracting Officer Representative.

D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alterative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity and permit for energized work has been reviewed and accepted by the Contracting Officer and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

E. Ground-fault circuit interrupters. GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to construction activity supplied by 125-volt, 15-, 20-, or 30- ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30- ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented in accordance with NFPA 70E - 2015, Chapter 1, Article 110.4(C)(2).

1.19 FALL PROTECTION

A. The fall protection (FP) threshold height requirement is 4ft for ALL WORK in government occupied sites, unless the OSHA 29 CFR 1926 or EM 385-1-1 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work. For work occurring at new “greenfield” sites or sites with 24/7 Contractor controlled 100% restricted access, the fall protection (FP) threshold height may be increased to 6ft unless the OSHA 29 CFR 1926 or EM 385-1-1 requirements are more stringent.

1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.

2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.

3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the

WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.

4. Fall protection while using a ladder will be governed by the more stringent of OSHA and EM 385-1-1 requirements.

1.20 SCAFFOLDS AND OTHER WORK PLATFORMS

A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.

B. The fall protection (FP) threshold height requirement is 4 ft as stated in Section 1.16.

C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.

1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.

2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.

3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.

4. Emergency descent devices shall not be used as working platforms.

D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:

1. The Competent Person's name and signature;

2. Dates of initial and last inspections.

E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

1.21 EXCAVATION AND TRENCHES

A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P. Excavations less than 5 feet in depth require evaluation by the contractor's "Competent Person" (CP) for determination of the necessity of an excavation protective system where kneeing, laying in, or stooping within the excavation is required.

B. All excavations and trenches 24 inches in depth or greater shall require a written trenching and excavation permit (NOTE – some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall have two sections, one section will be completed prior to digging or drilling and the other will be completed prior to personnel entering the excavations greater than 5 feet in depth. Each section of the permit shall be provided to the Resident Engineer prior to proceeding with digging or drilling and prior to proceeding with entering the excavation. After completion of the work and prior to opening a new section of an excavation, the permit shall be closed out and provided to the Resident Engineer. The permit shall be maintained onsite, and the first section of the permit shall include the following:

1. Estimated start time & stop time
2. Specific location and nature of the work.
3. Indication of the contractor's "Competent Person" (CP) in excavation safety with qualifications and signature. Formal course in excavation safety is required by the contractor's CP.
4. Indication of whether soil or concrete removal to an offsite location is necessary.
5. Indication of whether soil samples are required to determined soil contamination.
6. Indication of coordination with local authority (i.e. "One Call") or contractor's effort to determine utility location with search and survey equipment.
7. Indication of review of site drawings for proximity of utilities to digging/drilling.

C. The second section of the permit for excavations greater than five feet in depth shall include the following:

1. Determination of OSHA classification of soil. Soil samples will be from freshly dug soil with samples taken from different soil type layers as necessary and placed at a safe distance from the excavation by the excavating equipment. A pocket penetrometer will be utilized in determination of the unconfined compression strength of the soil for comparison against OSHA table (Less than 0.5 Tons/FT2 – Type C, 0.5 Tons/FT2 to 1.5 Tons/FT2 – Type B, greater than 1.5 Tons/FT2 – Type A without condition to reduce to Type B).

2. Indication of selected protective system (sloping/benching, shoring, shielding). When soil classification is identified as “Type A” or “Solid Rock”, only shoring or shielding or Professional Engineer designed systems can be used for protection. A Sloping/Benching system may only be used when classifying the soil as Type B or Type C. Refer to Appendix B of 29 CFR 1926, Subpart P for further information on protective systems designs.

3. Indication of the spoil pile being stored at least 2 feet from the edge of the excavation and safe access being provided within 25 feet of the workers.

4. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist. Internal combustion engine equipment is not allowed in an excavation without providing force air ventilation to lower the concentration to below OSHA PELs, providing sufficient oxygen levels, and atmospheric testing as necessary to ensure safe levels are maintained.

C. As required by OSHA 29 CFR 1926.651(b)(1), the estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

1. The planned dig site will be outlined/marked in white prior to locating the utilities.

2. Used of the American Public Works Association Uniform Color Code is required for the marking of the proposed excavation and located utilities.

3. 811 will be called two business days before digging on all local or State lands and public Right-of Ways.

4. Digging will not commence until all known utilities are marked.

5. Utility markings will be maintained

D. Excavations will be hand dug or excavated by other similar safe and acceptable means as excavation operations approach within 3 to 5 feet of identified underground utilities. Exploratory bar or other detection equipment will be utilized as necessary to further identify the location of underground utilities.

E. Excavations greater than 20 feet in depth require a Professional Engineer designed excavation protective system.

RESIDENT ENGINEER1.23 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

1.24 CONFINED SPACE ENTRY

A. All confined space entry shall comply with 29 CFR 1926, Subpart AA except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].

B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Resident Engineer.

1.25 WELDING AND CUTTING

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with the Resident Engineer. Obtain permits from the Resident Engineer and Facility Safety Officer at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.26 LADDERS

A. All Ladder use shall comply with 29 CFR 1926 Subpart X and EM 385-1-1.

B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.

C. Manufacturer safety labels shall be in place on ladders

D. Step Ladders shall not be used in the closed position

E. Top steps or cap of step ladders shall not be used as a step

F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.

1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.

2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.27 FLOOR & WALL OPENINGS

A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M and EM 385-1-1.

B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. Skylights located in floors or roofs are considered floor or roof hole/openings.

C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toe boards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.

1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.

2. Covers shall be secured when installed, clearly marked with the word “HOLE”, “COVER” or “Danger, Roof Opening-Do Not Remove” or color-coded or equivalent methods (e.g., red or orange “X”). Workers must be made aware of the meaning for color coding and equivalent methods.

3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.

4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.

5. Workers are prohibited from standing/walking on skylights.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
425 Eye Street N.W, (sixth floor)
Washington, DC 20001
Telephone Numbers: (202) 632-5249 or (202) 632-5178
Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA Aluminum Association Inc.
http://www.aluminum.org

AABC Associated Air Balance Council
https://www.aabc.com

AAMA American Architectural Manufacturer's Association
http://www.aamanet.org

AASHTO American Association of State Highway and Transportation Officials
http://www.aashto.org

AATCC American Association of Textile Chemists and Colorists
http://www.aatcc.org

ACGIH American Conference of Governmental Industrial Hygienists
http://www.acgih.org

ACI American Concrete Institute
http://www.aci-int.net

ACPA American Concrete Pipe Association
http://www.concrete-pipe.org

ACPPA American Concrete Pressure Pipe Association
http://www.acppa.org

ADC Air Diffusion Council
http://flexibleduct.org

AGA American Gas Association
http://www.aga.org

AGC Associated General Contractors of America
http://www.agc.org

AGMA American Gear Manufacturers Association, Inc.
http://www.agma.org

AH American Hort
https://www.americanhort.org

AHAM Association of Home Appliance Manufacturers
http://www.aham.org

AIA American Institute of Architects
http://www.aia.org

AISC American Institute of Steel Construction
http://www.aisc.org

AISI American Iron and Steel Institute
http://www.steel.org

AITC American Institute of Timber Construction
https://aitc-glulam.org

AMCA Air Movement and Control Association, Inc.
http://www.amca.org

ANSI American National Standards Institute, Inc.
http://www.ansi.org

APA The Engineered Wood Association
http://www.apawood.org

ARI Air-Conditioning and Refrigeration Institute
http://www.ari.org

ARPM Association for Rubber Product Manufacturers
https://arpm.com

ASABE American Society of Agricultural and Biological Engineers
https://www.asabe.org

ASCE American Society of Civil Engineers
http://www.asce.org

ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
http://www.ashrae.org

ASME American Society of Mechanical Engineers
http://www.asme.org

ASSE American Society of Sanitary Engineering International
http://www.asse-plumbing.org

ASTM American Society for Testing and Materials International
http://www.astm.org

AWI Architectural Woodwork Institute
https://www.awinet.org

AWS American Welding Society
https://www.aws.org

AWWA American Water Works Association
https://www.awwa.org

BHMA Builders Hardware Manufacturers Association
https://www.buildershardware.com

BIA The Brick Industry Association
http://www.gobrick.com

CAGI Compressed Air and Gas Institute
https://www.cagi.org

CGA Compressed Gas Association, Inc.
https://www.cganet.com

CI The Chlorine Institute, Inc.
https://www.chlorineinstitute.org

CISCA Ceilings and Interior Systems Construction Association
https://www.cisca.org

CISPI Cast Iron Soil Pipe Institute
https://www.cispi.org

CLFMI Chain Link Fence Manufacturers Institute
https://www.chainlinkinfo.org

CPA Composite Panel Association
https://www.compositepanel.org

CPMB Concrete Plant Manufacturers Bureau
https://www.cpmb.org

CRA California Redwood Association
http://www.calredwood.org

CRSI Concrete Reinforcing Steel Institute
https://www.crsi.org

CTI Cooling Technology Institute
https://www.cti.org

DHA Decorative Hardwoods Association
https://www.decorativehardwoods.org

DHI Door and Hardware Institute
https://www.dhi.org

EGSA Electrical Generating Systems Association
http://www.egsa.org

EEI Edison Electric Institute
https://www.eei.org

EPA	United States Environmental Protection Agency https://www.epa.gov
ETL	ETL Testing Services http://www.intertek.com
FAA	Federal Aviation Administration https://www.faa.gov
FCC	Federal Communications Commission https://www.fcc.gov
FPS	Forest Products Society http://www.forestprod.org
GANA	Glass Association of North America http://www.glasswebsite.com
FM	Factory Mutual Global Insurance https://www.fmglobal.com
GA	Gypsum Association https://gypsum.org
GSA	General Services Administration https://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
ICC	International Code Council https://shop.iccsafe.org
ICEA	Insulated Cable Engineers Association https://www.icea.net
ICAC	Institute of Clean Air Companies http://www.icac.com

IEEE Institute of Electrical and Electronics Engineers
https://www.ieee.org\

IGMA Insulating Glass Manufacturers Alliance
https://www.igmaonline.org

IMSA International Municipal Signal Association
http://www.imsasafety.org

MBMA Metal Building Manufacturers Association
https://www.mbma.com

MSS Manufacturers Standardization Society of the Valve and Fittings Industry
http://msshq.org

NAAMM National Association of Architectural Metal Manufacturers
https://www.naamm.org

PHCC Plumbing-Heating-Cooling Contractors Association
https://www.phccweb.org

NBS National Bureau of Standards
See - NIST

NBBI The National Board of Boiler and Pressure Vessel Inspectors
https://www.nationalboard.org

NEC National Electric Code
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association
https://www.nema.org

NFPA National Fire Protection Association
https://www.nfpa.org

NHLA National Hardwood Lumber Association
https://www.nhla.com

NIH National Institute of Health
https://www.nih.gov

NIST National Institute of Standards and Technology
https://www.nist.gov

NELMA Northeastern Lumber Manufacturers Association, Inc.
http://www.nelma.org

NPA National Particleboard Association
(See CPA, Composite Panel Association)

NSF National Sanitation Foundation
http://www.nsf.org

OSHA Occupational Safety and Health Administration
Department of Labor
https://www.osha.gov

PCA Portland Cement Association
https://www.cement.org

PCI Precast Prestressed Concrete Institute
https://www.pci.org

PPI Plastics Pipe Institute
https://www.plasticpipe.org

PEI Porcelain Enamel Institute
http://www.porcelainenamel.com

PTI Post-Tensioning Institute
http://www.post-tensioning.org

RFCI Resilient Floor Covering Institute
https://www.rfci.com

RIS Redwood Inspection Service
(See Western Wood Products Association)

https://www.wwpa.org

SCMA Southern Cypress Manufacturers Association
http://www.cypressinfo.org

SDI Steel Door Institute
http://www.steeldoor.org

SJI Steel Joist Institute
https://www.steeljoist.org

SMACNA Sheet Metal & Air-Conditioning Contractors' National Association
https://www.smacna.org

SSPC The Society for Protective Coatings
https://www.sspc.org

STI Steel Tank Institute
https://www.steeltank.com

SWI Steel Window Institute
https://www.steelwindows.com

TCNA Tile Council of North America
https://www.tcnatile.com

TEMA Tubular Exchanger Manufacturers Association
http://www.tema.org

TPI Truss Plate Institute
https://www.tpinst.org

UBC The Uniform Building Code
(See ICC)

UL Underwriters' Laboratories Incorporated
https://www.ul.com

ULC Underwriters' Laboratories of Canada

https://www.ulc.ca

WCLB West Coast Lumber Inspection Bureau

http://www.wclib.org

WDMA Window and Door Manufacturers Association

https://www.wdma.com

WRCLA Western Red Cedar Lumber Association

https://www.realcedar.com

WWPA Western Wood Products Association

http://www.wwpa.org

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SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for Contractor Quality Control (CQC) for Design-Bid-Build (DBB) or Design-Build (DB) construction projects. This section can be used for both project types.

1.2 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. ASTM International (ASTM)

1. D3740 - (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
2. E329 - (2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.3 SUBMITTALS

Government approval is required for all submittals. CQC inspection reports shall be submitted under this Specification section and follow the [Applicable CQC Control Phase (Preparatory, Initial, or Follow-Up)]: [Applicable Specification section] naming convention.

1. Preconstruction Submittals
   a. Interim CQC Plan
   b. CQC Plan
   c. Additional Requirements for Design Quality Control (DQC) Plan
2. Design Data
   a. Discipline-Specific Checklists
   b. Design Quality Control
3. Test Reports
   a. Verification Statement

PART 2 PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system. that complies with the FAR Clause 52.246.12 titled "Inspection of Construction". QC consists of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all design and construction operations, both onsite and offsite, and be keyed to the proposed design and construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Office or Authorized designee for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

3.2 CQC PLAN:

A. Submit the CQC Plan no later than 15 days after receipt of Notice to Proceed (NTP) proposed to implement the requirements of the FAR Clause 52.246.12 titled "Inspection of Construction". The Government will consider an Interim CQC Plan for the first 15 days of operation, which must be accepted within 10 business days of NTP. Design and/or construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an Interim plan applicable to the particular feature of work to be started. Work outside of the accepted Interim CQC Plan will not be permitted to begin until acceptance of a CQC Plan or another Interim CQC Plan containing the additional work scope is accepted.

B. Content of the CQC Plan: Include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, designers of record consultants, architects/engineers (A/E), fabricators, suppliers, and purchasing agents:

   1. A description of the QC organization, including a chart showing lines of authority and acknowledgement that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.

2. The name, qualifications (in resume format) duties, responsibilities, and authorities of each person assigned a CQC function.
3. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer or Authorized designee.
4. Procedures for scheduling, reviewing, certifying, and managing submittals including those of subcontractors, designers of record, consultants, A/E's offsite fabricators, suppliers and purchasing agents. These procedures must be in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
5. Control, verification, and acceptance of testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer or Authorized designee are required to be used)
6. Procedures for tracking Preparatory, Initial, and Follow-Up control phases and control, verification, and acceptance tests including documentation.
7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.
8. Reporting procedures, including proposed reporting formats.
9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of specifications can generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the Coordination meeting.
10. Coordinate schedule work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections and Schedule of Special Inspections. Where the applicable Code issue by the International Code Council (ICC) calls for

inspections by the Building Official, the Contractor must include the inspections in the CQC Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors. Include the Special Inspection Plan requirements in the CQC Plan.

C. Additional Requirements for Design Quality Control (DQC) Plan: The following additional requirements apply to the DQC Plan for DB projects only and not DBB projects:

1. Submit and maintain a DQC Plan as an effective QC program which assures that all services required by this contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, all documents must be technically reviewed by competent, independent reviewers identified in the DQC Plan. The same element that produced the product may not perform the independent technical review (ITR). Correct errors and deficiencies in the design documents prior to submitting them to the Government.
2. Include the design schedule in the master project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific Contract period. This should be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. Include review and correction periods associated with each item. This should be a forward planning as well as a project monitoring tool. The schedule reflects calendar days and not dates for each activity. If the schedule is changed, submit a revised schedule reflecting the change within 7 calendar days. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit at each design phase as part of the project documentation these completed discipline-specific checklists.
3. Implement the DQC Plan by a DQC Manager who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated. This individual must be a person who has verifiable engineering or architectural design experience and is a Professional Engineer or Registered Architect within the state of Construction location. Notify the Contracting Officer or Authorized designee, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

D. Acceptance of Plan: Acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the

Contractor to make changes in the CQC Plan and operations including removal of personnel as necessary, to obtain the quality specified.

E. Notification of Changes: After acceptance of the CQC Plan, notify the Contracting Officer or Authorized designee in writing of any proposed change. Proposed changes are subject to acceptance by the Government prior to implementation by the Contractor.

3.3 COORDINATION MEETING:

After the Preconstruction Conference Post-award Conference before start of design or construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized designee to discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 2 business days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CC operations, design activities (if applicable), control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and Contracting Officer or Authorized designee and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION:

A. Personnel Requirements: The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager, a Design Quality Manager (if applicable), and sufficient number of additional qualified personnel to ensure safety and Contract compliance. The Safety and Health Manager shall satisfy the requirements of Specification 01 35 26 Safety Requirements and reports directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer or

Authorized designee. Provide adequate office space, filing systems, and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawings submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Government.

B. CQC System Manager: Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager is required to be a graduate of construction management, with a minimum of 5 years construction experience on construction similar to the scope of this Contract. This CQC System manager is on the site at all times during construction and is employed by the General Contractor. The CQC System Manger is assigned as CQC System Manager but has duties as project superintendent in addition to quality control.

C. CQC Personnel: In addition to CQC personnel specified elsewhere in the contract, provide as part of the CQC organization specialized personnel to assist in the CQC System Manager for the following areas, as applicable: electrical, mechanical, civil, structural, environmental, architectural, materials technician submittals clerk, Commissioning Agent/LEED specialist, and low voltage systems. These individuals or specified technical companies are employees of the prime or subcontractor; are responsible to the CQC System Manager; are physically present at the construction site during work on the specialized personnel's areas of responsibility; and have the necessary education or experience in accordance with the Experience Matrix listed herein. These individuals can perform other duties but need to be allowed sufficient time to perform the specialized personnel's assigned quality controls duties as described in the CQC Plan. A single person can cover more than one area provided that the single person is qualified to perform QC activities in each designated and that workload allows.

EXPERIENCE MATRIX

Area	Qualifications
Civil	Graduate Civil Engineer or Construction Manager with 2 years experience in the type of work being performed on this project or technician with 5 years related experience.

Area	Qualifications
Mechanical	Graduate Mechanical Engineer with 2 years experience or construction professional with 5 years of experience supervising mechanical features of work in the field with a construction company.
Electrical	Graduate Electrical Engineer with 2 years related experience or construction professional with 5 years of experience supervising electrical features of work in the field with a construction company.
Structural	Graduate Civil Engineer (with Structural Track or Focus), Structural Engineer, or Construction Manager with 2 years experience or construction professional with 5 years experience supervising structural features of work in the field with a construction company.
Architectural	Graduate Architect with 2 years experience or construction professional with 5 years of related experience.
Environmental	Graduate Environmental Engineer with 3 years experience.
Submittals	Submittal Clerk with 1 year experience.
Concrete, Pavement, and Soils	Materials Technician with 2 years experience for the appropriate area.
Testing, Adjusting, and Balancing (TAB)	Specialist must be a member of AABC or an experienced technician of the firm certified by the NEBB.
Design Quality Control Manager	Registered Architect or Professional Engineer

D. Additional Requirements: In addition to the above experience and education requirements, the CQC System Manager and Alternate CQC System Manager are required to have completed the Construction Quality Management (CQM) for Construction course. If the CQC System Manager does not have a current specification, obtain the CQM for Contractors course identification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer or Authorized designee for information on the next scheduled class.

E. Organizational Changes: Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer or Authorized designee for acceptance.

3.5 SUBMITTALS AND DELIVERABLES: Submittals have to comply with the requirements in Section 01 33 23 Shop Drawings, Product Data, and Samples. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 01 91 00 General Commissioning Requirements is included in the contract, the submittals required by the section have to be coordinated with the Section 01 33 23 Shop Drawings, Product Data, and Samples to ensure adequate time is allowed for each type of submittal required.

3.6 CONTROL:

A. CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control are required to be conducted by the CQC System Manager for each definable feature of the construction work as follows:

1. Preparatory Phase: This phase is performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:
   a. A review of each paragraph of applicable specifications, references codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.
   b. Review of the Contract drawings.
   c. Check to assure that all materials and equipment have been tested, submitted, and approved.
   d. Review of provisions that have been made to provide required control inspection and testing.
   e. Review Special Inspections required by Section 01 45 35 Special Inspections, that Statement of Special Inspections and the Schedule of Specials Inspections.

f. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

g. Examination of required materials, equipment, and sample work to assure that they are on hand conform to approved shop drawings or submitted data, and are properly stored.

h. Review of the appropriate Activity Hazard Analysis (AHA) to assure safety requirements are met.

i. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards – contract defined or industry standard if not contract defined - for that feature of work.

j. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

k. Discussion of the initial control phase.

l. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the Preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the Preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

B. Initial Phase: This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the Preparatory meeting.
2. Verify adequacy of controls to ensure full contract compliance. Verify the required control inspection and testing is in compliance with the contract.
3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
4. Resolve all differences.
5. Check safety to include compliance with an upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

6. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the initial phase for definable features of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with Follow-Up phases.
7. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
8. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections.

C. Follow-Up Phase: Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements until the completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final Follow-Up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections

D. Additional Preparatory and Initial Phases on the same definable features of work if: the quality ongoing work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

A. Testing Procedure: Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and acceptance test when specified. Procure the services of a Department of Veteran Affairs approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.

3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
5. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the unique sequential control number identifying the test. If approved by the Contracting Officer or Authorized designee, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer or Authorized designee. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: All testing laboratories must be validated through the procedures contained in Specification section 01 45 29 Testing Laboratory Services.
   1. Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt and steel is required to meet criteria detailed in ASTM D3740 and ASTM E329.
   2. Capability Recheck: If the selected laboratory fails the capability check, the Contractor will be assessed a charge equal to value of recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

C. Onsite Laboratory: The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

A. Punch-Out Inspection: Conduct an inspection of the work by the CQC system Manager near the end of the work, or any increment of the work established by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to

ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final Inspection.

B. Pre-Final Inspection: The Government will perform the Pre-Final Inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final Acceptance Inspection with the customer can be scheduled. Correct any items noted on the Pre-Final Inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph need to be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate construction completion dates.

C. Final Acceptance Inspection: The Contractor's QC Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Authorized designee is required to be in attendance at the Final Acceptance Inspection. Additional Government personnel can also be in attendance. The Final Acceptance Inspection will be formally scheduled by the Contracting Officer's or Authorized designee based upon results of the Pre-Final Inspection. Notify the Contracting Officer through the Resident Engineer office at least 14 days prior to the Final Acceptance Inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date schedule for the Final Acceptance Inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with FAR Clause 52.246-12 titled "Inspection of Construction".

3.9 DOCUMENTATION

A. Quality Control Activities: Maintain current records providing factual evidence that required QC activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

1. The name and area of responsibility of the Contractor/Subcontractor
2. Operating plant/equipment with hours worked, idle, or down for repair.

3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
4. Test and control activities performed with results and references to specification/drawing requirements. Identify the Control Phase (Preparatory, Initial, and/or Follow-Up). List deficiencies noted, along with corrective action.
5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specification/drawing requirements.
6. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. Instructions given/received and conflicts in plans and specifications.
10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identification of the Independent Technical Reviewer (ITR) team, the ITR review comments, responses, and the record of resolution of the comments.

B. Verification Statement: Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily with 1 week after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit on report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the CQC System Manager. Include copies of test reports and copies of reports prepared by all subordinate QC personnel within the CQC System Manager Report.

3.10 SAMPLE FORMS

Templates of various quality control reports can be found on the Whole Building Design Guide website at https://www.wbdg.org/FFC/NAVGRAPH/01%2045%2000.00%2020_quality_control_reports.pdf

3.11 NOTIFICATION OF NONCOMPLIANCE: The Contracting Officer or Authorized designee will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor should take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer can issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

--- End of Section ---

SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

PERFORM: Perform these tasks for each weld, fastener or bolted connection, and noted verification.

OBSERVE: Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☐ B, ☒ C, ☐ D, ☐ E, ☐ F (check appropriate box)

DESIGNER NOTES (delete this box after reviewing):

1. This schedule contains minimum requirements. Do not delete applicable inspection tasks unless notes in blue indicate it is acceptable to do so.
2. Blue text = designers notes. The designer must review and edit all blue text in this schedule prior to inserting this schedule into the special inspections spec (UFGS 01 45 35).
3. Check section boxes with ANY inspection tasks applicable to your project. You may choose to delete unchecked sections or leave them in the schedule unchecked.
4. Individual rows/tasks that that are not applicable to the project may be left in the section, as the inspector can determine whether they occur/apply (e.g. metal trusses in the light gauge framing section for example).
5. Design discipline sections are color coded for easier reference by designers. This schedule does NOT need to be printed in color.
6. When finished editing, delete this note box and save this schedule as a PDF and insert into the project specifications (special inspections section).

STRUCTURAL - STEEL – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

STEEL INSPECTION PRIOR TO WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	**PERFORM**	
2. Verify manufacturer certifications for welding consumables are available	**PERFORM**	
3. Verify material identification	**PERFORM**	Type and grade.
4. Welder Identification System	**PERFORM**	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	**PERFORM**	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	**PERFORM**	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	**PERFORM AND DOCUMENT**	✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	**PERFORM**	
18. k-area	**PERFORM**	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	**PERFORM**	
20. Repair activities	**PERFORM AND DOCUMENT**	
21. Document acceptance or rejection of welded joint or member	**PERFORM**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacture's certifications available for fastener materials	**PERFORM**	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified nondestructive testing personnel	**PERFORM**	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: DOR may uncheck this section for projects NOT designed in accordance with AISC 341 (Seismic Provisions) or for projects designed according to AISC 341, but using an R value equal to 3]		
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	**PERFORM**	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION [1]

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Placement and installation of steel headed stud anchors	**PERFORM**	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

END SECTION

STRUCTURAL - STEEL - OTHER INSPECTIONS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	**PERFORM**	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	**DOCUMENT**	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	**DOCUMENT**	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	**DOCUMENT**	No holes or unapproved attachments made by the responsible contractor

END SECTION

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[1] See Concrete Construction Section for all concrete related inspection of composite steel construction.

[2] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

METAL DECK INSPECTION PRIOR TO DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	**PERFORM**	
2. Document acceptance or rejection of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION DURING DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	**PERFORM**	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	**PERFORM**	
5. Document acceptance or rejection of installation of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION AFTER DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Welding procedure specification (WPS) available	**PERFORM**	
7. Manufactures certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

METAL DECK INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	**PERFORM**	
6. Welds meet visual acceptance criteria	**PERFORM**	
7. Verify repair activities	**PERFORM**	
8. Document acceptance or rejection of welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

METAL DECK INSPECTION BEFORE MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION DURING MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION AFTER MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	**PERFORM**	
6. Check spacing, type, and installation of sidelap fasteners	**PERFORM**	
7. Check spacing, type, and installation of perimeter fasteners	**PERFORM**	
8. Verify repair activities	**PERFORM**	
9. Document acceptance or rejection of mechanical fasteners	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	**PERFORM**	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs. **[NOTE: DOR must identify critical wind and/or seismic force resisting welds in the contract drawings so that the special inspector can confirm compliance.]**
3. Connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs. **[NOTE: DOR must identify critical wind and/or seismic force resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]**
4. Cold-formed steel (progressive collapse resisting system where/if applies)	OBSERVE	Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03). **[NOTE: DOR must identify critical progressive collapse resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]**

END SECTION

STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	**CONTINUOUS**	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	**CONTINUOUS AND DOCUMENT**	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	**CONTINUOUS**	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	**CONTINUOUS**	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	**CONTINUOUS**	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE AT START OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
4. Prestressing technique	OBSERVE	
5. Properties of thin bed mortar for AAC masonry	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE PRIOR TO GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Grout space	OBSERVE	
7. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
8. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
9. Placement of masonry units and mortar joints	OBSERVE	
10. Welding of reinforcement	**CONTINUOUS**	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE DURING CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Size and location of structural elements is in compliance	OBSERVE	
12. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°c) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
13. Application and measurement of prestressing force	**CONTINUOUS**	
14. Placement of grout and prestressing grout for bonded tendons	**CONTINUOUS**	
15. Placement of AAC masonry units and construction of thin bed mortar joints	**CONTINUOUS**	Continuous for first 5000 square feet only (465 square meters).
16. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

END SECTION

STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION

THIS SECTION IS APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE (CONTINUOUS FOR GLUING)	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors (double top plates), braces, hold downs, roof connections to exterior walls.

END SECTION

STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC TABLE 1705.12.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents
2. Testing of seismic isolation Systems in seismically isolated structures		Seismic Isolation Systems in seismically isolated structures shall be tested accordance with ASCE 7, Section 17.8

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

GEOTECHNICAL - SOILS INSPECTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	**OBSERVE**	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	**CONTINUOUS**	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION

GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	**CONTINUOUS**	
2. Inspect driving operations and maintain complete and accurate records for each element	**CONTINUOUS**	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achiever design capacity, record tip and butt elevations and document any damage to foundation element	**CONTINUOUS**	
4. Determine capacities of test elements and conduct additional load tests if required.	**CONTINUOUS**	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.9		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	**CONTINUOUS**	

END SECTION

GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	**CONTINUOUS**	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	**CONTINUOUS**	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

[1] **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.14		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION

FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.15		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION

FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.17		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.18		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570. **[NOTE: not applicable to masonry or concrete wall applications. Uncheck this section in those cases]**

END SECTION

ARCHITECTURAL – ARCHITECTURAL COMPONENTS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf**
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if interior non-load bearing walls weigh less than 15psf**
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents.
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. **Inspector Note: Not required for racks less than 8 feet in height**

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

Project: Ehrm Infrastructure
Location: White River
Project #: 689-22-700
Date: 02/05/2025

STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: C
Project Risk Category: IV
Project Design Wind Speed (mph): 0
Number of Stories: 4
Structure Height Above Grade (ft): 100
Hazardous Occupancy or attached to such? No Group H Occupancies

Special Inspector of Record (SIOR)

A Special Inspector of Record (SIOR) **IS NOT** required (per UFGS 01 45 35, Section 1.3.8)

Lateral Force Resisting System (LFRS)

2018 IBC 1704.3.2 and 1704.3.3

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsiblities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

Vertical LFRS Elements	Notes
None	

Horizontal LFRS Elements	Notes
None	

Project: Ehrm Infrastructure
Location: White River
Project #: 689-22-700
Date: 02/05/2025

Designated Seismic Systems (DSS)

(2018 IBC 1705.13.3) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-1, 2-5.3)

Non-structural 'Designated Seismic Systems' (DSS) must remain operable and contain hazardous substances following a design earthquake. Accordingly, all Designated Seismic Systems must be listed below and must be certified by the manufacturer to remain both operable and/or to contain hazardous substances after a design earthquake per UFC 3-301-01, Section 3-6.2. Submit said Certificates of Compliance to the Contracting Officer for each DSS after they have been reviewed and accepted by the EOR/DOR.

Additionally, the below listed Designated Seismic Systems must be carefully inspected by the Special Inspector according to the requirements noted in the Schedule of Special Inspections, Section AA.

ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance	
1.	DSS Emergency or Standby Power System
2.	DSS Component XX
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance	
1.	DSS Gas lines and associated fittings, anchorage, & flexible Connections
2.	DSS Component XX
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX
6.	DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance	
1.	DSS Building egress stair systems
2.	DSS Building fire sprinkler systems
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX
6.	DSS Component XX

Final Walk Down Inspection and Report

(UFC 3 301 01 SECTION 2-5.4)

Designated Seismic Systems shall receive a final walk-down inspection by the Registered Design Professional in Responsible Charge

Final Walk Down Report, Prepared by the Registered Design Professional in Responsible Charge, Must Include:

1. Record observations of Final Walk Down Inspection
2. Document that Inspections were performed in accordance with the Schedule of Special Inspections
3. Document that all Designated Seismic Systems are installed according to construction/manufacturer document requirements, and that Compliance Certificates have been collected (UFC 03 301 01, 3-6.2, 13.2.2.2).

SECTION 01 45 35
SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This guide specification will be applicable to both new buildings and existing building rehabilitations/renovations. In addition to the Special Inspection and testing specified requirements, a registered design professional must perform structural observations during construction. All observed deficiencies will be immediately reported to the Contracting Officer. The registered design professional performing these observations will be a representative of the Designer of Record (DOR) for the building being constructed.

B. Structural observations are required for the following project conditions per IBC Chapter 17:

1. Seismic Design Category D, E or F; and assigned to Risk Cat III, IV or V.
2. The structure is classified as Risk Category IV
3. The structure is a high rise building
4. Such observation is required by the registered design professional responsible for the structural design.
5. Such observation is specifically required by the building official.
6. Seismic Design Category D, E or F; and with a height greater than 22860 mm 75 ft.
7. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two stories above grade plane.
8. Nominal design wind speed in excess of 58 m/sec 130 mph; and assigned to Risk Cat III, IV or V.

APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. American Society of Civil Engineers (ASCE)

1. ASCE 7 - (2010; Errata 2011; Supp 2 2013) Minimum Design Loads for Buildings and Other Structures

C. International Code Council (ICC)

2. ICC IBC - (2021) International Building Code

1.2 GENERAL REQUIREMENTS

A. Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the prime contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

B. Structural observations will be performed by the Government. The contractor must provide notification to the Contracting Officer 14 days prior to the following points of construction that structural observations need to occur:

1. The government shall perform structural observations for the completed concrete foundation reinforcement before the concrete pour.
2. The Government shall perform structural observations for the completed CMU wall and cast-in-place anchors before the final grout pour
3. The Government shall perform structural observations for the completed beams and metal deck installation.

1.3 DEFINITIONS

A. Continuous Special Inspections – The constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

B. Periodic Special Inspections – Special Inspections by the special inspector who is intermittently present where the work to be inspected has been or is being performed. Specific time interval on a specific Special Inspection should be indicated on the Schedule of Special Inspections.

C. Perform – Perform these Special Inspections tasks for each welded joint or member.

D. Observe – Observe these Special Inspections items on a random daily basis. Operations need not be delayed pending these inspections.

E. Special Inspector (SI) – A qualified person retained by the contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

F. Associate Special Inspector (ASI) – A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

G. Third Party – A third party inspector must not be company employee of the Contractor or any Sub-Contractor performing the work to be inspected.

H. Special Inspector of Record (SIOR) – SIOR must be an independent third party hired directly by the Prime Contractor and is required for the following project conditions:

1. Seismic Design Category D, E, or F; and assigned to Risk Category III, IV, or V.
2. Structure is classified as a risk category III, IV, or V.
3. Seismic Design Category D, E, or F; and with a height greater than 22860mm 75 ft.
4. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two (2) stories above grade plane.
5. Nominal design wind speed in excess o f49 m/sec 100 mph; and assigned to Risk Category III, IV, or V.
6. Nominal design wind speed in excess of 49 mm/sec 100mph; and with a height greater than 23m 75ft.
7. In addition to these conditions, the DOR is encouraged to consider using an SIOR on large magnitude or critical projects where this additional level of quality control is affordable.

I. Contracting Officer – The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

J. Contractor’s Quality Control (QC) Manager – An individual retained by the prime contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the contractor's QC organization.

K. Designer of Record (DOR) – A registered design professional is contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The DOR is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in state in which the design professional works. The DOR is also referred to as the Engineer of Record (EOR) in design code documents.

L. Statement of Special Inspections (SSI) – A document developed by the DOR identifying the material, systems, components and work required to have Special Inspections and covering the following:

1. List of the Architectural Designated Seismic Systems – these components are in or attached to a Risk Category IV or V structure and are needed for continued operation of the facility or their failure could impair the continued operation of the facility.
2. List of the Mechanical Designated Seismic Systems
   a. For Seismic Design Category C or Risk V, list the following:
      1) Heating, ventilation, and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork
      2) Piping systems and mechanical units containing flammable, combustible, or highly toxic materials.
   b. For Seismic Design Category D, E, or F or Risk Category V list mechanical system that meet one of the following:
      1) Life safety component required to function after an earthquake
      2) Component that contains hazardous content,
      3) All components in an essential facility needed for continued operation after an earthquake.
3. List of the Electrical Designated Systems
   a. For Seismic Design Category C or Risk V, list the anchorage of electrical equipment used for emergency or standby power systems.
   b. For Seismic Design Category D, E or F list electrical system that meet one of the following:
      1) Life safety component required to function after an earthquake
      2) Component that contains hazardous content,
      3) All components in an essential facility needed for continued operation after an earthquake.
4. List of elements that are part of the progressive collapse resistance system.
   a. Provide a description of the following as they apply:
      1) Elements of the tie force system consisting of internal longitudinal and transverse, vertical, and peripheral tie.
      2) Elements of the alternate path system.

3) Elements having enhanced local resistance. The Statement of Special Inspections and the Schedule of Special Inspections will be included as an attachment to this specification

a) Schedule of Special Inspections – A schedule which lists each of the required Special Inspections, the extent to which each Special Inspections is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. Template found here:

SECTION 01 45 35 Schedule of SI Temp

SECTION 01 45 35 Statement of SI Tem

b) Designated Seismic System – Those nonstructural components that require design in accordance with ASCE 7 Chapter 13 and for which the component importance factor, Ip, is greater than 1.0. This designation applies to systems that are required to be operational following the Design Earthquake for RC I - IV structures and following the MCER for RC V structures. All systems in RC V facilities designated as MC-1 in accordance with UFC 3-310-04 are considered part of the Designated Seismic Systems.

M. Submittals: Government approval is required for all submittals. CQC Special Inspection reports shall be submitted under this Specification section and follow the [Special Inspection]: [Applicable Specification section or description] naming convention. Submit the following:

1. SD-01 Preconstruction Submittals;
2. SIOR Letter of Acceptance;
3. Special Inspections Project Manual;
4. Special Inspections Agency's Written Practices
5. NDT Procedures and Equipment’ Calibration Records;
6. SD-06 Test Reports;
7. Special Inspections
8. Daily Reports;
9. Special Inspections; Biweekly Reports;
10. SD-07 Certificates;
11. Fabrication Plant
12. Steel Truss Plant;

13. Wood Truss Plant;
14. AC472 Accreditation;
15. Steel Joist Institute Membership;
16. Precast Concrete Institute (PCI) Certified Plant;
17. Certificate of Compliance;
18. Special Inspector of Record Qualifications;
19. Special Inspector Qualifications;
20. Qualification Records for NDT technicians;
21. SD-11 Closeout Submittals;
22. Interim Final Report of Special Inspections;
23. Comprehensive Final Report of Special Inspections;

N. Special Inspector Qualifications: Submit qualifications for each SI, ASI, and the SIOR from the following certifying associations: Associated Air Balance Council (AABC); American Concrete Institute (ACI); Association of the Wall and Ceiling Industry (AWCI); American Welding Society (AWS); Factory Mutual (FM); International Code Council (ICC); Nondestructive Testing (NDT); National Institute for Certification in Engineering Technologies (NICET); Precast/Prestressed Concrete Institute (PCI); Post-Tensioning Institute (PTI); Underwriters Laboratories (UL). Qualifications should be in accordance with the following minimums

QUALIFICATIONS

Area	Special Inspector	Associated Special Inspector	SIOR
Steel Construction and High Strength Bolting	ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or Registered Professional Engineer with related experience.	Engineer-In-Training with one year of related experience.	
Welding Structural Steel (For highly complex steel use only AWS Certified Welding Inspectors)	ICC Welding Special Inspector certificate with one year of related experience or AWS Certified Welding Inspector	AWS Certified Associate Welding Inspector	

Area	Special Inspector	Associated Special Inspector	SIOR
Nondestructive Testing of Welds	NDT Level II Certificate	NDT Level II Certificate plus one year of related experience	
Cold Formed Steel Framing	ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or ICC Commercial Building Inspector with one year of experience; or Registered Professional Engineer with related experience.	Engineer-In-Training with one year of related experience.	
Concrete Construction	ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or ACI Concrete Construction Special Inspector, or NICET Concrete Technician Level III Certificate in Construction Materials Testing, or, Registered Professional Engineer with related experience	ACI Concrete Construction Special Inspector in Training, or Engineer-In-Training with one year of related experience	
Prestressed Concrete Construction	ICC Pre-stressed Special Inspector Certificate with one year of related experience, or PCI Quality Control Technician/ Inspector Level II Certificate with one year of related experience, or Registered Professional Engineer with related experience.	PCI Quality Control Technician/ Inspector Level I Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Post-Tensioned Concrete Construction	PTI Level 2 Unbonded PT Inspector Certificate, or Registered Professional Engineer with related experience	PTI Level 1 Unbonded PT Inspector Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	

Area	Special Inspector	Associated Special Inspector	SIOR
Masonry Construction	ICC Structural Masonry Special Inspector Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Wood	ICC Commercial Building Inspector Certificate with one year of related experience, or ICC Residential Building Inspector with on year of experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Verification of Site Soil Condition, Fill Placement, and Load-Bearing Requirements	ICC Soils Special Inspector Certificate with one year of related experience, or NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience	NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction, or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	

Area	Special Inspector	Associated Special Inspector	SIOR
Deep Foundations	NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience	NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Sprayed Fire Resistant Manual	ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Mastic and Intumescent Fire Resistant Coatings	ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	
Exterior Insulation and Finish Systems (EIFS)	AWCI EIFS Inspector Certificate, or Exterior Design Institute Certificate, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	

Area	Special Inspector	Associated Special Inspector	SIOR
Fire-Resistant Penetrations and Joints	Passed the UL Firestop Exam with one year of related experience, or Passed the FM Firestop Exam with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	
Smoke Control	AABC Technician Certification with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	
SIOR			Registered Professional Engineer

PART 2 - PRODUCTS

2.1 FABRICATORS SPECIAL INSPECTION

A. Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the applicable certification(s) from the following list to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

B. The following certifications meet the requirements for fabricator approval in accordance with paragraph 1704.2.5.2 of IBC:

1. American Institute of Steel Construction (AISC) Certified Fabrication Plant, Category STD.
2. Truss Plate Institute (TPI) steel truss plate quality assurance program certification.
3. Truss Plate Institute (TPI) wood truss plate quality assurance program certification.
4. International Accreditation Service, AC472 Accreditation Steel Joist Institute Membership
5. Precast Concrete Institute (PCI) Certified Plant, Group C

C. At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special **Inspections, stating that the materials supplied and work performed by** the fabricator are in accordance the construction documents.

PART 3 - EXECUTION

3.1 RESPONSIBILIES MATRIX

Inspector	Responsibility	Condition
SIOR	a. Supervise all Special Inspectors required by the contract documents and the IBC. b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR. c. Verify the qualifications of all of the Special Inspectors. d. Verify the qualifications of fabricators.	Applicable when SIOR is required
	e. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following: 1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel. 2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection. f. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.	Applicable when SIOR is required and when the structural design is required to follow AISC341 for seismic design of steel structures
	g. Prepare a Special Inspections Project Manual, which will cover the following: 1. Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, General Contractor, Subcontractors, QC Manager, and DOR. 2. Organizational chart and/or communication plan, indicating lines of communication 3. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors. Contractor's internal plan for	Applicable when SIOR is required

Inspector	Responsibility	Condition
	scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors. 4. Indicate the government reporting procedures. 5. Propose forms or templates to be used by SI and SIOR to document inspections. 6. Indicate procedures for tracking nonconforming work and verification that corrective work is complete. 7. Indicate how the SIOR and/or SI will participate in weekly QC meetings. 8. Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified per paragraph FABRICATOR SPECIAL INSPECTIONS. 9. Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work. Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval. h. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party. i. Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR. j. Submit a copy of the Special Inspector's daily reports to the QC Manager. k. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.	

Inspector	Responsibility	Condition
	l. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following: 1. A brief summary of the work performed during the reporting time frame. 2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems, that were observed during the reporting period. 3. Discrepancies which were resolved or corrected. 4. A list of nonconforming items requiring resolution. 5. All applicable test results including nondestructive testing reports.	
QC Manager	a. If there is no SIOR, QC Manager must Supervise all Special Inspectors required by the contract documents and the IBC; Verify the qualifications of all of the Special Inspectors; Verify the qualifications of fabricators; Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR.	Applicable when SIOR is not required
	b. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.	n/a
Special Inspectors	a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections. b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.	
	c. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following: 1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel. 2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.	Applicable when SIOR is NOT required and when the structural design is required to follow AISC 341 for seismic

Inspector	Responsibility	Condition
	d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.]	design of steel structures
	f. Submit a copy of the daily reports to the QC Manager. g. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report. h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following: 1. A brief summary of the work performed during the reporting time frame 2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems that were observed during the reporting period. 3. Discrepancies which were resolved or corrected. 4. A list of nonconforming items requiring resolution. 5. All applicable test result including nondestructive testing reports. j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.	Applicable when SIOR is not required
	k. Submit daily reports to the SIOR	Applicable when SIOR is required

3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Government to accept such work.

-- End of Section –

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:

1. Adversely affect human health or welfare,
2. Unfavorably alter ecological balances of importance to human life,
3. Effect other species of importance to humankind, or;
4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:

1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
   a. Sewage: Domestic sanitary sewage and human and animal waste.

b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES

Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. U.S. National Archives and Records Administration (NARA):

33 CFR 328 ..... Definitions

1.4 SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer's Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:

   a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.

   b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.

   c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

   d. Description of the Contractor's environmental protection personnel training program.

e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

h. Permits, licenses, and the location of the solid waste disposal area.

i. Inclusion of “best management practices” and methodologies.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted. Provide erosion control plans, in phases where required.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, landforms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
    a. Box and protect from damage existing trees and shrubs to remain on the construction site.
    b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
    c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
    a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of the local (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
    b. Reuse or conserve the collected topsoil sediment as directed by the COR. Topsoil use and requirements are specified in Section 31 21 11, EARTHWORK (SHORT FORM).
    c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features as noted on the plans. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.

6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
7. Manage and control spoil areas on Government property to limit spoil to areas shown on the plans and prevent erosion of soil or sediment from entering nearby water courses or lakes.
8. Protect adjacent areas from despoilment by temporary excavations and embankments.
9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
11. Handle discarded materials other than those included in the solid waste category as directed by the COR.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
3. Monitor water areas affected by construction.

D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the

State Air Pollution Statue, Rule, or Regulation and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 7:00 a.m. and 4:00 p.m. unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
   a. Maintain maximum permissible construction equipment noise levels at 15 meter (50 feet) (dBA):

EARTHMOVING MATERIALS HANDLING

FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75		
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

b. Use shields or other physical barriers to restrict noise transmission.

c. Provide soundproof housings or enclosures for noise-producing machinery.

d. Use efficient silencers on equipment air intakes.

e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.

f. Line hoppers and storage bins with sound deadening material.

g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.

G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional

cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.

C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:

D. Waste Management Plan development and implementation.

E. Techniques to minimize waste generation.

F. Sorting and separating of waste materials.

G. Salvage of existing materials and items for reuse or resale.

H. Recycling of materials that cannot be reused or sold.

I. At a minimum the following waste categories shall be diverted from landfills:

1. Soil.
2. Inerts (e.g., concrete, masonry and asphalt).
3. Clean dimensional wood and palette wood.
4. Green waste (biodegradable landscaping materials).
5. Engineered wood products (plywood, particle board and I-joists, etc.).
6. Metal products (e.g., steel, wire, beverage containers, copper, etc.).
7. Sheathings
8. Cardboard, paper and packaging.
9. Bitumen roofing materials.
10. Plastics (e.g., ABS, PVC).
11. Carpet and/or pad.
12. Gypsum board.
13. Insulation.
14. Paint.
15. Fluorescent lamps.

1.2 RELATED WORK

A. Section 02 41 19, SELECTIVE DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

1. C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.
2. D. Division 1 Sustainability specifications

1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

1. Excess or unusable construction materials.
2. Packaging used for construction products.
3. Poor planning and/or layout.
4. Construction error.
5. Over ordering.
6. Weather damage.
7. Contamination.
8. Mishandling.
9. Breakage.

B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.

C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.

D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.

H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.

C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.

D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.

E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).

F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.

H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.

I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.

J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
   1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
   2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.

M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.

N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.

O. Return: To give back reusable items or unused products to vendors for credit.

P. Salvage: To remove waste materials from the site for resale or re-use by a third party.

Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.

R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.

S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
   1. Procedures to be used for debris management.
   2. Techniques to be used to minimize waste generation.
   3. Analysis of the estimated job site waste to be generated:
      a. List of each material and quantity to be salvaged, reused, recycled.
      b. List of each material and quantity proposed to be taken to a landfill.
   4. Detailed description of the Means/Methods to be used for material handling.

a. On site: Material separation, storage, protection where applicable.

b. Off site: Transportation means and destination. Include list of materials.

1) Description of materials to be site-separated and self-hauled to designated facilities.

2) Description of mixed materials to be collected by designated waste haulers and removed from the site.

a) The names and locations of mixed debris reuse and recycling facilities or sites.

b) The names and locations of trash disposal landfill facilities or sites.

c) Documentation that the facilities or sites are approved to receive the materials.

C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.

D. Monthly summary of construction and demolition n debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

E. Target waste diversion rate by material and an overall diversion rate.

F. Final report documenting the results of implementation of the preconstruction waste management plan.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

B. U.S. Green Building Council (USGBC): LEED Green Building Rating System for New Construction

1. Green Building Initiative (GBI): Green Globes for New Construction 2019

1.7 RERESIDENT ENGINEERDS

A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the Green Globes for New Construction 2019 Technical Reference Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. List of each material and quantity to be salvaged, recycled, reused.

B. List of each material and quantity proposed to be taken to a landfill.

C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.

B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.

B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

- - - E N D - - -

SECTION 01 81 13
SUSTAINABLE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes general requirements and procedures to comply with federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable construction.

B. The Design Professional has selected materials and utilized integrated design processes that achieve the Government's objectives. Contractor is responsible to maintain and support these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes. Obtain approval from Contracting Officer for all changes and substitutions to materials or processes. Proposed changes must meet, or exceed, materials or processes specified.

1.2 RELATED WORK

A. Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

B. Section 01 74 19 CONSTRUCTION WASTE MANANGEMENT.

C. Section 01 81 13.21 SUSTAINABILITY CERTIFICATION REQUIREMENTS - GREEN GLOBES.

D. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 DEFINITIONS

A. Recycled Content: Recycled content of materials is defined according to Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260). Recycled content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine recycled content value.

1. "Post-Consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-Consumer" material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

B. Biobased Products: Biobased products are derived from plants and other renewable agricultural, marine, and forestry materials and provide an alternative to conventional petroleum derived

products. Biobased products include diverse categories such as lubricants, cleaning products, inks, fertilizers, and bioplastics.

C. Low Pollutant-Emitting Materials: Materials and products which are minimally odorous, irritating, or harmful to comfort and well-being of installers and occupants.

D. Volatile Organic Compounds (VOC): Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.4 REFERENCE STANDARDS

A. Carpet and Rug Institute Green Label Plus program.

B. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

C. U.S. Environmental Protection Agency Comprehensive Procurement Guidelines (CPG).

D. U.S. Environmental Protection Agency WaterSense Program (WaterSense).

E. U.S. Environmental Protection Agency ENERGY STAR Program (ENERGY STAR).

F. U. S. Department of Energy Federal Energy Management Program (FEMP).

G. Green Electronic Council EPEAT Program (EPEAT).

1.5 SUBMITTALS

A. All submittals to be provided by contractor to COR.

B. Sustainability Action Plan:

1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
3. Sustainability Action Plan must:
   a. Make reference to sustainable construction submittals defined by this section.
   b. Address all items listed under PERFORMANCE CRITERIA.
   c. Indicate individual(s) responsible for implementing the plan.

C. Low Pollutant-Emitting Materials Tracking Spreadsheet: Within 30 days after Preconstruction Meeting provide a preliminary Low Pollutant-Emitting Materials Tracking Spreadsheet. The Low Pollutant-Emitting Materials Tracking Spreadsheet must be an electronic file and include all materials on Project in categories described under Low Pollutant-Emitting Materials in 01 81 13.

D. Construction Indoor Air Quality (IAQ) Management Plan:
   1. Not more than 30 days after Preconstruction Meeting provide a Construction IAQ Management Plan as an electronic file including descriptions of the following:
      a. Instruction procedures for meeting or exceeding minimum requirements of ANSI/SMACNA 008-2008, Chapter 3, including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling.
      b. Instruction procedures for protecting absorptive materials stored on-site or installed from moisture damage.
      c. Schedule of submission of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials.
      d. Instruction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille.
      e. Instruction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit.
      f. Instruction procedures and schedule for implementing building flush-out.

E. Product Submittals:
   1. Recycled Content: Submit product data from manufacturer indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content (excluding MEP systems equipment and components).
   2. Biobased Content: Submit product data for products to be installed or used which are included in any of the USDA BioPreferred program's product categories. Data to include percentage of biobased content and source of biobased material.
   3. Low Pollutant-Emitting Materials: Submit product data confirming compliance with relevant requirements for all materials on Project in categories described under Low Pollutant-Emitting Materials in 01 81 13.
   4. For applicable products and equipment, submit product documentation confirming ENERGY STAR label, FEMP certification, WaterSense, and/or EPEAT certification.

F. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, submit a Sustainable Construction Progress Report to confirm adherence with Sustainability Action Plan.

1. Include narratives of revised strategies for bringing work progress into compliance with plan and product submittal data.
2. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
3. Include construction waste tracking, in tons or cubic yards, including waste description, whether diverted or landfilled, hauler, and percent diverted for comingled quantities; and excluding land-clearing debris and soil. Provide haul receipts and documentation of diverted percentages for comingled wastes.

G. Closeout Submittals: Within 14 days after Substantial Completion provide the following:
1. Final version of Low Pollutant-Emitting Materials Tracking Spreadsheet.
2. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed air handling units are used during construction.
3. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for final filtration media in air handling units.
4. Minimum 18 construction photographs including six photographs taken on three different occasions during construction of ANSI/SMACNA 008-2008, Chapter 3 approaches employed, along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
5. Flush-out Documentation:
   a. Product data for filtration media used during flush-out.
   b. Product data for filtration media installed immediately prior to occupancy.
   c. Signed statement describing building air flush-out procedures including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

1.6 QUALITY ASSURANCE

A. Preconstruction Meeting: After award of Contract and prior to commencement of Work, schedule and conduct meeting with COR/Resident Engineer and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the

Sustainable Construction Requirements and coordination of contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.

B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

C. Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

D. Green Seal Standard GC-36, Commercial Adhesives, October 19, 2000.

E. South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

F. South Coast Air Quality Management District (SCAQMD) Rule 1168, July 1, 2005 and rule amendment date of January 7, 2005.

G. Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition (ANSI/SMACNA 008-2008), Chapter 3.

H. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, Emission Testing method for California Specification 01350 (CDPH Standard Method V1.1-2010).

I. Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260).

J. ASHRAE Standard 52.2-2007.

PART 2 – PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Construction waste diversion from landfill disposal must comprise at least 50 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal.

B. Low Pollutant-Emitting Materials:

1. Adhesives, sealants and sealant primers applied on site within the weatherproofing membrane must comply with VOC limits of SCAQMD Rule 1168:
    a. Flooring Adhesives and Sealants:
        1) Indoor carpet adhesives: 50 g/L.
        2) Wood Flooring Adhesive: 100 g/L.
        3) Rubber Floor Adhesives: 60 g/L.
        4) Subfloor Adhesives: 50 g/L.
        5) Ceramic Tile Adhesives and Grout: 65 g/L.
        6) Cove Base Adhesives: 50 g/L.
        7) Multipurpose Construction Adhesives: 70 g/L.
        8) Porous Material (Except Wood) Substrate: 50 g/L.
        9) Wood Substrate: 30 g/L.
        10) Architectural Non-Porous Sealant Primer: 250 g/L.
        11) Architectural Porous Sealant Primer: 775 g/L.
        12) Other Sealant Primer: 750 g/L.
        13) Structural Wood Member Adhesive: 140 g/L.
        14) Sheet-Applied Rubber Lining Operations: 850 g/L.
        15) Top and Trim Adhesive: 250 g/L.
        16) Architectural Sealant: 250 g/L.
        17) Other Sealant: 420 g/L.
    b. Non-Flooring Adhesives and Sealants:
        1) Drywall and Panel Adhesives: 50 g/L.
        2) Multipurpose Construction Adhesives: 70 g/L.
        3) Structural Glazing Adhesives: 100 g/L.
        4) Metal-to-Metal Substrate Adhesives: 30 g/L.
        5) Plastic Foam Substrate Adhesive: 50 g/L.
        6) Porous Material (Except Wood) Substrate Adhesive: 50 g/L.
        7) Wood Substrate Adhesive: 30 g/L.
        8) Fiberglass Substrate Adhesive: 80 g/L.
        9) Architectural Non-Porous Sealant Primer: 250 g/L.
        10) Architectural Porous Sealant Primer: 775 g/L.
        11) Other Sealant Primer: 750 g/L.

12) PVC Welding Adhesives: 510 g/L.
13) CPVC Welding Adhesives: 490 g/L.
14) ABS Welding Adhesives: 325 g/L.
15) Plastic Cement Welding Adhesives: 250 g/L.
16) Adhesive Primer for Plastic: 550 g/L.
17) Contact Adhesive: 80 g/L.
18) Special Purpose Contact Adhesive: 250 g/L.
19) Structural Wood Member Adhesive: 140 g/L.
20) Sheet Applied Rubber Lining Operations: 850 g/L.
21) Top and Trim Adhesive: 250 g/L.
22) Architectural Sealants: 250 g/L.
23) Other Sealants: 420 g/L.

2. Aerosol adhesives applied on site within the weatherproofing membrane must comply with the following Green Seal GS-36.
   a. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent VOCs by weight.
   b. Aerosol Adhesive, General-Purpose Web Spray: 55 percent VOCs by weight.
   c. Special-Purpose Aerosol Adhesive (All Types): 70 percent VOCs by weight.
3. Paints and coatings applied on site within the weatherproofing membrane must comply with the following criteria:
   a. VOC content limits for paints and coatings established in Green Seal Standard GS-11.
   b. VOC content limit for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates of 250 g/L established in Green Seal GC-03.
   c. Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed VOC content limits established in SCAQMD Rule 1113.
   d. Comply with the following VOC content limits:
      1) Anti-Corrosive/Antirust Paints: 250 g/L.
      2) Clear Wood Finish, Lacquer: 550 g/L.
      3) Clear Wood Finish, Sanding Sealer: 350 g/L.
      4) Clear Wood Finish, Varnish: 350 g/L.
      5) Floor Coating: 100 g/L.
      6) Interior Flat Paint, Coating or Primer: 50 g/L.

7) Interior Non-Flat Paint, Coating or Primer: 150 g/L.
8) Sealers and Undercoaters: 200 g/L.
9) Shellac, Clear: 730 g/L.
10) Shellac, Pigmented: 550 g/L.
11) Stain: 250 g/L.
12) Clear Brushing Lacquer: 680 g/L.
13) Concrete Curing Compounds: 350 g/L.
14) Japans/Faux Finishing Coatings: 350 g/L.
15) Magnesite Cement Coatings: 450 g/L.
16) Pigmented Lacquer: 550 g/L.
17) Waterproofing Sealers: 250 g/L.
18) Wood Preservatives: 350 g/L.
19) Low-Solids Coatings: 120 g/L.

4. Carpet installed in building interior must comply with one of the following:
   a. Meet testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
   b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at the 14-day time point.
5. Each non-carpet flooring element installed in building interior which is not inherently non-emitting (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) must comply with one of the following:
   a. Meet requirements of the FloorScore standard as shown with testing by an independent third-party.
   b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at 14-day time point.
6. Composite wood and agrifiber products used within the weatherproofing membrane must contain no added urea-formaldehyde resins.
7. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde.

C. Recycled Content:

1. Any products being installed or used that are listed on EPA Comprehensive Procurement Guidelines designated product list must meet or exceed the EPA's recycled content recommendations. The EPA Comprehensive Procurement Guidelines categories include:
    a. Building insulation.
    b. Cement and concrete.
    c. Consolidated and reprocessed latex paint.
    d. Floor tiles.
    e. Flowable fill.
    f. Laminated paperboard.
    g. Modular threshold ramps.
    h. Non-pressure pipe.
    i. Patio blocks.
    j. Railroad grade crossing surfaces.
    k. Roofing materials.
    l. Shower and restroom dividers/partitions.
    m. Structural fiberboard.
    n. Nylon carpet and nylon carpet backing.
    o. Compost and fertilizer made from recovered organic materials.
    p. Hydraulic mulch.
    q. Lawn and garden edging.
    r. Plastic lumber landscaping timbers and posts.
    s. Park benches and picnic tables.
    t. Plastic fencing.
    u. Playground equipment.
    v. Playground surfaces.
    w. Bike racks.

D. Biobased Content:
1. Materials and equipment being installed or used that are listed on the USDA BioPreferred program product category list must meet or exceed USDA's minimum biobased content threshold. Refer to individual specification sections for detailed requirements applicable to that section.
    a. USDA BioPreferred program categories include:

1) Adhesive and Mastic Removers.
2) Carpets.
3) Cleaners.
4) Composite Panels.
5) Corrosion Preventatives.
6) Erosion Control Materials.
7) Dust Suppressants.
8) Fertilizers.
9) Floor Cleaners and Protectors.
10) Floor Coverings (Non-Carpet).
11) Glass Cleaners.
12) Hydraulic Fluids.
13) Industrial Cleaners.
14) Interior Paints and Coatings.
15) Mulch and Compost Materials.
16) Multipurpose Cleaners.
17) Multipurpose Lubricants.
18) Packaging Films.
19) Paint Removers.
20) Plastic Insulating Foam.
21) Pneumatic Equipment Lubricants.
22) Roof Coatings.
23) Wastewater Systems Coatings.
24) Water Tank Coatings.
25) Wood and Concrete Sealers.
26) Wood and Concrete Stains.

E. Materials, products, and equipment being installed which fall into a category covered by the WaterSense program must be WaterSense-labeled or meet or exceed WaterSense program performance requirements, unless disallowed for infection control reasons.

1. WaterSense categories include:
   a. Bathroom Faucets
   b. Commercial Toilets

c. Irrigation Controllers

d. Pre-Rinse Spray Valves

e. Residential Toilets

f. Showerheads

g. Spray Sprinkler Bodies

h. Urinals

F. Materials, products, and equipment being installed which fall into any of the following product categories must be Energy Star-labeled.

1. Applicable Energy Star product categories as of 09/14/2017 include:

a. Appliances:

1) Air Purifiers and Cleaners.

2) Clothes Dryers (Residential).

3) Clothes Washers (Commercial & Residential).

4) Dehumidifiers.

5) Dishwashers (Residential).

6) Freezers (Residential).

7) Refrigerators (Residential).

b. Electronics and Information Technology:

1) Audio/Video Equipment.

2) Computers.

3) Data Center Storage.

4) Digital Media Player.

5) Enterprise Servers.

6) Imaging Equipment.

7) Monitors.

8) Professional Displays.

9) Set-Top and Cable Boxes.

10) Telephones.

11) Televisions.

12) Uninterruptible Power Supplies.

13) Voice over Internet Protocol (VoIP) Phones.

c. Food Service Equipment (Commercial):

1) Dishwashers.
2) Fryers.
3) Griddles.
4) Hot Food Holding Cabinets.
5) Ice Makers.
6) Ovens.
7) Refrigerators and Freezers.
8) Steam Cookers.
9) Vending Machines.

d. Heating and Cooling Equipment:

1) Air-Source Heat Pumps (Residential).
2) Boilers.
3) Ceiling Fans (Residential).
4) Central Air Conditioners (Residential).
5) Ductless Heating and Cooling (Residential).
6) Furnaces (Residential).
7) Water Heaters.
8) Geothermal Heat Pumps (Residential).
9) Light Commercial Heating and Cooling Equipment.
10) Room Air Conditioners (Residential).
11) Ventilation Fans (Residential).

e. Other:

1) Decorative Light Strings.
2) Electric Vehicle Supply Equipment.
3) Laboratory-Grade Refrigerators and Freezers.
4) Light Bulbs.
5) Light Fixtures.
6) Pool Pumps.
7) Roof Products.
8) Water Coolers.
9) Windows, Doors, and Skylights.

G. Materials, products, and equipment being installed which fall into any of the following categories must be FEMP-designated. FEMP-designated product categories as of 09/14/2017 include:
   1. Boilers (Commercial).
   2. Dishwashers (Commercial).
   3. Electric Chillers, Air-Cooled (Commercial).
   4. Electric Chillers, Water-Cooled (Commercial).
   5. Exterior Lighting.
   6. Fluorescent Ballasts.
   7. Fluorescent Lamps, General Service.
   8. Ice Machines, Water-Cooled.
   9. Industrial Lighting (High/Low Bay).
   10. Light Emitting Diode (LED) Luminaires.

H. Electronic products and equipment being installed which fall into any of the following categories shall be EPEAT registered. Electronic products and equipment covered by EPEAT program as of 09/14/2017 include:
   1. Computers.
   2. Displays.
   3. Imaging Equipment.
   4. Televisions.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Construction Indoor Air Quality Management:
   1. During construction, meet or exceed recommended control measures of ANSI/SMACNA 008-2008, Chapter 3.
   2. Protect stored on-site and installed absorptive materials from moisture damage.
   3. If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda). Replace all filtration media immediately prior to occupancy.
   4. Perform building flush-out as follows:

a. After construction ends, prior to occupancy and with interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 degrees Fahrenheit and a relative humidity no higher than 60 percent. OR

b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it must be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or design minimum outside air rate determined until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space. During each day of flush-out period, ventilation must begin a minimum of three hours prior to occupancy and continue during occupancy.

5. Provide construction dust control to comply with SCAQMD Rule 403.

-----END----

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING DESCRIPTION

A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 7, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:

1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
2. Verify and document proper integrated performance of equipment and systems.
3. Verify that Operations & Maintenance documentation is complete.
4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
6. Document the successful achievement of the commissioning objectives listed above.

F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the Resident Engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.

B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to VA Resident Engineer and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the Resident Engineer and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the Resident Engineer.

C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.

D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of

the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:

1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.
5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.
B. Section 01 32.16.15 PROJECT SCHEDULES (SMALL PROJECTS – DESIGN/BID/BUILD)
C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
D. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS
E. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
F. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.

1.4 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council's (USGBC) LEED ™ rating program and to support delivery of project performance in accordance with the VA requirements developed for the project to support the following credits:

1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" and the prerequisite of "Fundamental Building Systems Commissioning."
2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

D. The commissioning activities have been developed to support the Green Buildings Initiative's Green Globes rating program and to support delivery of project performance in accordance with the VA requirements developed for the project.

1.5 ACRONYMS

List of Acronyms	
Acronym	Meaning
A/E	Architect / Engineer Design Team
AHJ	Authority Having Jurisdiction
ASHRAE	Association Society for Heating Air Condition and Refrigeration Engineers
BOD	Basis of Design
BSC	Building Systems Commissioning
CCTV	Closed Circuit Television
CD	Construction Documents
CMMS	Computerized Maintenance Management System
CO	Contracting Officer (VA)
COR	Contracting Officer's Representative (see also VA-RE)

List of Acronyms	
Acronym	Meaning
COBie	Construction Operations Building Information Exchange
CPC	Construction Phase Commissioning
Cx	Commissioning
CxA	Commissioning Agent
CxM	Commissioning Manager
CxR	Commissioning Representative
DPC	Design Phase Commissioning
FPT	Functional Performance Test
GBI-GG	Green Building Initiative - Green Globes
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
NC	Department of Veterans Affairs National Cemetery
NCA	Department of Veterans Affairs National Cemetery Administration
NEBB	National Environmental Balancing Bureau
O&M	Operations & Maintenance
OPR	Owner's Project Requirements
PFC	Pre-Functional Checklist
PFT	Pre-Functional Test
SD	Schematic Design
SO	Site Observation
TAB	Test Adjust and Balance
VA	Department of Veterans Affairs
VAMC	VA Medical Center
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office
VA PM	VA Project Manager
VA-RE	VA Resident Engineer
USGBC	United States Green Building Council

1.6 DEFINITIONS

Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

Accuracy: The capability of an instrument to indicate the true value of a measured quantity.

Back Check: A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

Benchmarks: Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself.. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

Building Information Modeling (BIM): Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D, and provides reports both in 2D views and as schedules. This electronic information can be extracted and reused for pre-populating facility management CMMS systems. Building Systems Commissioning (BSC): NEBB acronym used to designate its commissioning program.

Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

CCTV: Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

COBie: Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (http://www.wbdg.org/resources/cobie.php)

Commissionability: Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned

Commissioning Agent (CxA): The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

Commissioning Checklists: Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also – Commissioning Observation).

Commissioning Manager (CxM): A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Commissioning Plan: A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.

Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Deficiency: See "Commissioning Issue".

Design Criteria: A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR.

Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.

Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of

utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

Owner's Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.

Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

Range: The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

Site Observation Reports (SO): Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

Start Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

Trending: Monitoring over a period of time with the building automation system.

Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the VA. Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on

verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

Whole Building Commissioning: Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

1.7 SYSTEMS TO BE COMMISSIONED

A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

Systems To Be Commissioned	
System	**Description**
HVAC	
Direct Digital Control System**	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
HVAC Ventilation/Exhaust Systems	General exhaust
HVAC Energy Recovery Systems**	Energy Recovery Ventilator
HVAC Terminal Unit Systems**	VAV Terminal Units, CAV terminal units, fan coil units, fin-tube radiation, unit heaters
Decentralized Unitary HVAC Systems*	Split-system HVAC systems, Data Center CRAC Systems controls, interface with facility DDC

Systems To Be Commissioned	
System	**Description**
Humidity Control Systems	Humidifiers, de-humidifiers, controls, interface with facility DDC
Electrical	
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc)
Emergency Power Generation Systems	Generators, Generator paralleling switchgear, automatic transfer switches, PLC and other control systems
Lighting & Lighting Control** Systems	Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
Cathodic Protection Systems	Review 3rd party testing results.
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	Witness 3rd party testing, review reports
Electronic Safety and Security	

Systems To Be Commissioned	
System	**Description**
Integrated Systems Tests	
Loss of Power Response	Loss of power to building, loss of power to campus, restoration of power to building, restoration of power to campus. UPS Monitoring, and UPS Systems.
Fiber Feeds	Fiber Feeds and IT Layouts
Table Notes	
** Denotes systems that LEED requires to be commissioned to comply with the LEED Fundamental Commissioning pre-requisite.	

1.8 COMMISSIONING TEAM

A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by Contractor:

1. Contractor' Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

C. Members Appointed by VA:

1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.

2. User: Representatives of the facility user and operation and maintenance personnel.
3. A/E: Representative of the Architect and engineering design professionals.

1.9 VA'S COMMISSIONING RESPONSIBILITIES

A. Appoint an individual, company or firm to act as the Commissioning Agent.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
   1. Coordination meetings.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Testing meetings.
   4. Witness and assist in Systems Functional Performance Testing.
   5. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.

B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.

C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
   1. Participate in commissioning coordination meetings.
   2. Conduct operation and maintenance training sessions in accordance with approved training plans.
   3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
   4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In

collaboration with entity responsible for system and equipment installation, recommend corrective action.

5. Review and comment on commissioning documentation.
6. Participate in meetings to coordinate Systems Functional Performance Testing.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
8. Provide information to the Commissioning Agent for developing commissioning plan.
9. Participate in training sessions for VA's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.

C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.

E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.

G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.

H. Coordinate Systems Functional Performance Testing schedule with the Contractor.

I. Witness selected systems startups.

J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.

K. Witness and document Systems Functional Performance Testing.

L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.

N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.

O. Prepare commissioning Field Observation Reports.

P. Prepare the Final Commissioning Report.

Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.12 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
3. Identification of systems and equipment to be commissioned.
4. Schedule of Commissioning Coordination meetings.
5. Identification of items that must be completed before the next operation can proceed.
6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.
8. Description of requirements for operation and maintenance training.
9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
12. Preliminary Systems Functional Performance Test procedures.

B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested system.

2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Observations and Issues.
8. Issue number, if any, generated as the result of test.

C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.

1. Creating an Commissioning Issues Log Entry:
    a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
    b. Assign a descriptive title for the issue.
    c. Identify date and time of the issue.
    d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
    e. Identify system, subsystem, and equipment to which the issue applies.
    f. Identify location of system, subsystem, and equipment.
    g. Include information that may be helpful in diagnosing or evaluating the issue.
    h. Note recommended corrective action.
    i. Identify commissioning team member responsible for corrective action.
    j. Identify expected date of correction.
    k. Identify person that identified the issue.
2. Documenting Issue Resolution:
    a. Log date correction is completed or the issue is resolved.
    b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
    c. Identify changes to the Contract Documents that may require action.
    d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
    e. Identify person(s) who corrected or resolved the issue.
    f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract

Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
5, Commissioning Issues Log.
6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.

H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:

1. Documentation of deferred and off season test(s) results.
2. Completed Systems Functional Performance Test Procedures for off season test(s).
3. Documentation that unresolved system performance issues have been resolved.
4. Updated Commissioning Issues Log, including status of unresolved issues.
5. Identification of potential Warranty Claims to be corrected by the Contractor.

I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:

1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
2. Reference to Final Commissioning Plan.
3. Reference to Final Commissioning Report.
4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.13 SUBMITTALS

A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:

1. The Commissioning Team: A list of commissioning team members by organization.
2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the

Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.

E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.

F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA Resident Engineer with copies to the Contractor and Architect.

G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.

H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.

I. Data for Commissioning:

1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.
2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.14 COMMISSIONING PROCESS

A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks,

including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.

B. Within 30 days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within 60 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning

activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall

have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

Construction Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Construction Commissioning Kick Off meeting	L	A	P	P	O	
	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Controls Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.	L	A	P	P	N/A	
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O	

Construction Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	TAB Plan Review	L	A	R	R	O	
	Submittal and Shop Drawing Review	R	A	R	L	O	
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A	
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A	
Site Observations	Witness Factory Testing	P	A	P	L	O	
	Construction Observation Site Visits	L	A	R	R	O	

Construction Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O	
	Final Functional Performance Test Protocols	L	A	R	R	O	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	

B. The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

Acceptance Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Pre-Test Coordination Meeting	L	A	P	P	O	
	Lessons Learned and Commissioning Report Review Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O	
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O	
Schedules	Prepare Functional Test Schedule	L	A	R	R	O	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O	
	Pre-Functional Checklist Verification	L	A	R	R	O	
	Review Operations & Maintenance Manuals	L	A	R	R	R	
	Training Plan Review	L	A	R	R	R	
	Warranty Review	L	A	R	R	O	

Acceptance Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
	Review TAB Report	L	A	R	R	O	
Site Observations	Construction Observation Site Visits	L	A	R	R	O	
	Witness Selected Equipment Startup	L	A	R	R	O	
Functional Test Protocols	TAB Verification	L	A	R	R	O	
	Systems Functional Performance Testing	L	A	P	P	P	
	Retesting	L	A	P	P	P	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
	Systems Training	L	S	R	P	P	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	
	Final Commissioning Report	L	A	R	R	R	
	Prepare Systems Manuals	L	A	R	R	R	

C. The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

Warranty Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Post-Occupancy User Review Meeting	L	A	O	P	P	
Site Observations	Periodic Site Visits	L	A	O	O	P	
Functional Test Protocols	Deferred and/or seasonal Testing	L	A	O	P	P	
Technical Activities	Issues Resolution Meetings	L	S	O	O	P	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	L	A		R	P	

Warranty Phase		CxA = Commissioning Agent					L = Lead
Commissioning Roles & Responsibilities		RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Reports and Logs	Final Commissioning Report Amendment	L	A		R	R	
	Status Reports	L	A		R	R	

3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
   a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
   b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.
2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
   a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
   b. The full startup plan shall at a minimum consist of the following items:
      1) The Pre-Functional Checklists.
      2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
      3) The manufacturer's normally used field checkout sheets.
   c. The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.

d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.

3. Sensor and Actuator Calibration
   a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.
   b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
4. Execution of Equipment Startup
   a. Four (4) weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
   b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
   c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
   d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.

B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of

Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.

C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.4 PHASED COMMISSIONING

A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.5 DDC SYSTEM TRENDING FOR COMMISSIONING

A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.

B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers – Critical, Priority, and Maintenance.

1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.
2. Priority level alarms are to be printed to a printer which is connected to the Operator’s Work Station located within the engineer’s office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.
3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer’s office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the Resident Engineer and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing – Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the Resident Engineer. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the Resident Engineer, prior to the execution of Systems Functional Performance Testing.
2. Dynamic plotting – The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.
3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.
4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional

Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.

2-Pipe Fan Coil Unit Trending and Alarms							
Point	**Type**	**Trend Interval**	**Operational Trend Duration**	**Testing Trend Duration**	**Alarm Type**	**Alarm Range**	**Alarm Delay**
Space Temperature	AI	15 Minutes	12 hours	3 days	P	±5°F from SP	10 min
SA Temperature	AI	15 Minutes	12 hours	3 days	P	±5°F from SP	10 min
Pre-Filter Status	AI	None	None	None	M	> SP	1 hour
Water Sensor	DI	COV	12 hours	3 days	M	N/A	30 Min
Cooling Coil Valve Position	AO	15 Minutes	12 hours	3 days	N/A		
Fan Coil ON/OFF	DO	COV	12 hours	3 days	M	Status <> Command	30 min

Unit HeaterDuctless Split Trending and Alarms							
Point	**Type**	**Trend Interval**	**Operational Trend Duration**	**Testing Trend Duration**	**Alarm Type**	**Alarm Range**	**Alarm Delay**
Space Temperature	AI	15 Minutes	12 hours	3 days	P	±5°F from SP	10 min
Space Humidity	AI	15 Minutes	12 hours	3 days	P	>60% RH	10 min
Fan Speed	AO	15 Minutes	12 hours	3 days	N/A		
Unit ON/OFF	DO	COV	12 hours	3 days	M	Status <> Command	30 min

E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the Resident Engineer and Commissioning Agent.

1. Point-to-Point checkout documentation;
2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

SYSTEM		
Sensor	**Calibration Frequency**	**O&M Calibration Procedure Reference**
Discharge air temperature	Once a year	Volume I Section D.3.aa
Discharge static pressure	Every 6 months	Volume II Section A.1.c

4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

AIR HANDLING UNIT AHU-1				
Control Reference	Proportional Constant	Integral Constant	Derivative Constant	Interval
Heating Valve Output	1000	20	10	2 sec.

3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test

Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:

1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments.

16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.

1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.

B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.
3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
   a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor’s response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.

b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
   a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor’s response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
   b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
   c. The Commissioning Agent will document the resolution process.
   d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:
   1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
   2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.

B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's Resident Engineer, VA's Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:

1. Review the Contract Documents.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Review and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:

1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

5. Demonstration and Training Recording:
    a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
    b. Video Format: Provide high quality color DVD color on standard size DVD disks.
    c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
    d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    e. Submit two copies within seven days of end of each training module.
6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. Quality Assurance:
    1. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
    2. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
    3. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

E. Training Coordination:
    1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.

2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. Instruction Program:

1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.
   b. Intrusion detection systems.
   c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.
   d. Medical equipment, including medical gas equipment and piping.
   e. Laboratory equipment, including laboratory air and vacuum equipment and piping.
   f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.
   g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
   h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.
   i. HVAC instrumentation and controls.
   j. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
   k. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.
   l. Lighting equipment and controls.
   m. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.

n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   H, Performance curves.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.

d. Regulation and control procedures.

e. Control sequences.

f. Safety procedures.

g. Instructions on stopping.

h. Normal shutdown instructions.

i. Operating procedures for emergencies.

j. Operating procedures for system, subsystem, or equipment failure.

k. Seasonal and weekend operating instructions.

l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.

b. Checking adjustments.

c. Noise and vibration adjustments.

d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.

b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.

b. Types of cleaning agents to be used and methods of cleaning.

c. List of cleaning agents and methods of cleaning detrimental to product.

d. Procedures for routine cleaning

e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.

g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.

b. Repair instructions.

c. Disassembly; component removal, repair, and replacement; and reassembly instructions.

d. Instructions for identifying parts and components.

e. Review of spare parts needed for operation and maintenance.

H. Training Execution:

1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.

2. Instruction:

a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.

b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

2) The VA will furnish an instructor to describe VA's operational philosophy.

3) The VA will furnish the Contractor with names and positions of participants.

3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.

4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.

5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:

1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.

2. Video Format: Provide high quality color DVD color on standard size DVD disks.

3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

----- END -----

SECTION 02 82 11
TRADITIONAL ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

A. Contract Documents and Related Requirements: Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show or describe the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

B. Extent of Work:

1. Below is a brief description of the estimated quantities of asbestos containing materials to be abated. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy themselves of the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
2. Removal, clean-up and disposal of asbestos containing materials (ACM) and asbestos/waste contaminated elements or debris in an appropriate regulated area for the following approximate quantities;

   (20) square meters (feet) of duct insulation.
   (80) square meters (feet) of drywall and/or drywall joint compound.

C. Related Work:

1. Section 07 84 00, FIRESTOPPING
2. Division 09, FINISHES
3. Division 22, PLUMBING
4. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
5. Section 22 11 00, FACILITY WATER DISTRIBUTION
6. Section 22 13 00, FACILITY SANITARY AND VENT PIPING SEWERAGE
7. Section 23 05 11, COMMON WORK RESULTS FOR HVAC
8. Section 23 07 11, HVAC INSULATION
9. Section 23 21 13, HYDRONIC PIPING
10. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING
11. Section 23 37 00, AIR OUTLETS AND INLETS

D. Tasks:

1. The work tasks are summarized briefly as follows:
   a. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for asbestos abatement work.
   b. Abatement activities including removal, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.
   c. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

E. Contractors Use of Premises:

2. The Contractor and Contractor's personnel shall cooperate fully with the VA representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the VA specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State and Local regulations and requirements. Agreed
3. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved VA Design and Construction Procedures. VA Design and Construction Procedures drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination

facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing from the VA representative through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings:

1.2 VARIATIONS IN QUANTITY

A. The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. Accordingly, minor variations (+/- 10 percent) in quantities of ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the contractor shall provide unit prices for newly discovered ACM and those prices shall be used for additional work required under the contractor.

1.3 STOP ASBESTOS REMOVAL

A. If the Contracting Officer; their field representative; the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. Work stoppage will continue until conditions have been corrected to the satisfaction of the VA. Standby time and costs for corrective actions will be borne by the Contractor, including the VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities if:

4. Airborne PCM analysis results equal to or greater than 0.01 f/cc above background levels inside the building but outside the regulated area;
5. breach or break in regulated area containment barrier(s);
6. less than –0.02 inch WCG pressure in the regulated area;
7. serious injury/death at the site;
8. fire/safety emergency at the site;
9. respiratory protection system failure;
10. power failure or loss or inadequate use of wetting agent;
11. any visible emissions observed outside the regulated area; or
12. failure to follow project specification requirements.

1.4 DEFINITIONS

A. General: Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents, but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

B. Glossary:

Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aerosol - Solid or liquid particulate suspended in air.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive air sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 3, Fifth Edition is used to determine the fiber levels in air. For personal samples, area air samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis, the NIOSH Method 7402 (Issue 2, Fourth Edition) can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester (MCE) membrane for PCM (Phase Contrast Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.8 micron pore size) and MCE for TEM (Transmission Electron Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.45 micron pore size).

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

Asbestos-containing material (ACM) - Any material containing more than one percent of asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-contaminated soil (ACS) – Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

Asbestos-containing waste (ACW) material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos Project Monitor – Some states require that any person conducting asbestos abatement air sampling, clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the VA, the Contractor, or government agency and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the VA; the contractor; or any government agency representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of 2-layers of 6-mil independently installed plastic sheeting (Polyethylene) secured in place at openings such as doors, windows, penetrations or any other opening into the regulated area.

Primary Barrier – Plastic barriers placed over critical barriers and exposed directly to abatement work or to secondary barrier.

Secondary Barrier - Any additional plastic barriers used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - A person certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the VA's professional industrial hygiene consultant/Certified Industrial Hygienist (VPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may report to a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace – An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Disposal bag - Typically 6-mil thick sift-proof, dustproof, leak-tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance – Asbestos Operations and Maintenance Activities (OSHA Class III) that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag, which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift-proof, dustproof, and leak-tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an air tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width (aspect) ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure in order to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than one (1) percent asbestos as determined using the method specified in 40 CFR 763, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter – An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

HEPA vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist (IH) - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician (IH Technician) - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned. Some states require that an industrial hygienist technician conducting asbestos abatement air sampling, clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL or Excursion Limit (EL).

Negative pressure - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02 inch water column gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air pressure outside the respirator facepiece.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators to remove organic vapor hazardous air contaminants.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for as an eight (8) hour time-weighted average (TWA). For asbestos fibers, the eight (8) hour time-weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit (EL) is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) – equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, fall protection, and respirators.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or more workers within the regulated area using a filter cassette and a calibrated air sampling pump to determine asbestos exposure.

Pipe tunnel – An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, debris or asbestos-contaminated soil.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6-mils thick, semi-transparent, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator, respectively.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge, or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (k)(5).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of four projects of similar complexity with this project of which at least three projects serving as the supervisory IH. The PIH may be either the VA's PIH (VPIH/CIH) or Contractor's PIH (CPIH/CIH).

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Subpart E, Appendix C, Part I; (B)(5).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-2018.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, decorative, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

VA Professional Industrial Hygienist (VPIH/CIH) – The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may report to a Certified Industrial Hygienist (CIH).

VA Representative - The VA official responsible for on-going project work.

VA Total – means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM/ACS or ACM waste material.

Waste/Equipment decontamination facility (W/EDF) – The area in which equipment is decontaminated before removal from the regulated area.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

C. Referenced Standards Organizations: See Section 01 42 19 REFERENCED STANDARDS.

1.5 APPLICABLE CODES AND REGULATIONS

A. General Applicability of Codes, Regulations, and Standards:

1. All work under this contract shall be done in strict accordance with all applicable Federal, State, and Local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
2. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.
3. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system and/or the Contractor's on-site Field Office. These standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 may be made available electronically.

B. Asbestos Abatement Contractor Responsibility: The Asbestos Abatement Contractor (Contractor) shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE), respiratory

protection, and respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The Contractor will incur all costs of the CPIH/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State/Local requirements related to failure to comply with the regulations applicable to the work.

C. Federal Requirements:

1. Federal requirements which govern asbestos abatement include, but are not limited to, the following regulations:
   a. Occupational Safety and Health Administration **(OSHA)**
      1)Title 29 CFR 1926.1101 - Construction Standard for Asbestos
      2)Title 29 CFR 1926 Subpart E - Personal Protective Equipment and Life Saving Equipment
      3)Title 29 CFR 1910.134 - Respiratory Protection
      4)Title 29 CFR 1926 - Construction Industry Standards
      5)Title 29 CFR 1926.33 - Access to Employee Exposure and Medical Records
      6)Title 29 CFR 1926.59 same as 1910.1200 - Hazard Communication
      7)Title 29 CFR 1926 Subpart C – General Safety and Health Provisions and Subpart D – Occupational Health and Environmental Controls
   b. Environmental Protection Agency **(EPA)**:
      1)40 CFR 61 Subpart M - National Emission Standard for Hazardous Air Pollutants - Asbestos.
      2)40 CFR 763 - Asbestos Hazard Emergency Response Act (AHERA) and Asbestos Hazard Abatement Reauthorization Act (ASHARA)
   c. Department of Transportation **(DOT)**
      1)Title 49 CFR 171 - 180 – Transportation

D. State Requirements:

1. State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to The Vermont Department of Health Title 18, Chapter 26.

E. Local Requirements:

1. If local requirements are more stringent than federal or state standards, the local standards are to be followed.

F. Standards:

1. Standards which govern asbestos abatement activities include, but are not limited to, the following:
   a. American National Standards Institute (ANSI)/ASSP Z9.2-2018 - Fundamentals Governing the Design and Operation of Local Exhaust Systems and ANSI/ASSE Z88.2-2015 - Practices for Respiratory Protection.
   b. Underwriters Laboratories (UL) 586-2009 - UL Standard for Safety of HEPA Filter Units, 9th Edition; ANSI Approval 2017-12-19.
2. Standards which govern encapsulation work include, but are not limited to the following:
   a. American Society for Testing and Materials International (ASTM)
3. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
   a. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
   b. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.
   c. NFPA 101 - Life Safety Code

G. EPA Guidance Documents:

1. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference.
2. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
3. Asbestos Waste Management Guidance EPA 530-SW-85-007
4. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001
5. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

H. Notices:

1. State and Local agencies: Send written notification as required by State and Local regulations prior to beginning any work on ACM as outlined in the Vermont Department of Health, Title 18, Chapter 26.
2. Copies of notifications shall be submitted to the VA for the facility's records in the same time frame notification are given to EPA, State, and Local authorities.

I. Permits/Licenses: The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

J. Posting and Filing of Regulations: Maintain two (2) copies of applicable Federal, State, and Local regulations. Post one copy of each in the clean room at the regulated area where workers will have daily access to the regulations and keep another hard copy or electronic copy in the Contractor's office.

K. VA Responsibilities prior to commencement of work:

1. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment, and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area**.
2. Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized, calibration data and method of analysis. During abatement, submit to the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

L. Emergency Action Plan and Arrangements:

1. An Emergency Action Plan shall be developed prior to commencing abatement activities and shall be agreed to by the Contractor and the VA. The Plan shall meet the requirements of 29 CFR 1926, Subpart C, Standard 1926.35 Employee Emergency Action Plans.
2. Emergency procedures shall be in written form and prominently posted in the clean room and equipment room of the decontamination unit. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.
3. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule; layout of regulated area; and access to the regulated area, particularly barriers that may affect response capabilities.
4. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.

5. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.
   a. For non-life-threatening situations - employees injured or otherwise incapacitated shall be decontaminated following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.
   b. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, medical personnel shall remove them from the regulated area if back or neck injury is present, and secure proper medical treatment.
6. Telephone numbers of any/all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
7. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3-4 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
8. The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

M. Pre-Construction Meeting:

1. Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (VPIH/CIH) to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:
   a. Proof of Contractor licensing.
   b. Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.

c. A list of all workers who will participate in the project, including experience and verification of training and accreditation.

d. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.

e. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).

f. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.

g. A copy of the Contractor's Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project.

1)Regulated area preparation procedures;

2)Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d) Multi-Employer Worksites;

3)Decontamination area set-up/layout and decontamination procedures for employees;

4)Abatement methods/procedures and equipment to be used;

5)Personal protective equipment to be used.

h. At this meeting the Contractor shall provide all submittals as required.

i. Procedures for handling, packaging and disposal of asbestos waste.

j. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

A. The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1. Personnel:

a. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.

b. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative.

A request for approval shall be submitted for any person to be employed during the project giving the person's name; last four digits of social security number; qualifications; accreditation card with color picture, if required by state; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.

c. Minimum qualifications for Contractor and assigned personnel are:

1)The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of Federal (and State or Local as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable state; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.

2)The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project within the past three (3) years; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.

3)The Contractor Professional Industrial Hygienist/CIH (CPIH/CIH) shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has specialized EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course or equivalent, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.

4)The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the

Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

d. All personnel shall be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

A. General - Respiratory Protection Program: The Contractor shall develop and implement a written Respiratory Protection Program (RPP) which is in compliance with OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.134. ANSI Standard Z88.2-2015 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written RPP shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c) - Respiratory Protection Program.

B. Respiratory Protection Program Coordinator: The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years of experience coordinating RPP of similar size and complexity. The RPPC must submit a signed statement attesting to the fact that the program meets the above requirements.

C. Selection and Use of Respirators: The procedure for the selection and use of respirators must be submitted to the VA as part of the Contractor's qualifications. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit or in the onsite Contractor’s office, for reference by employees or authorized visitors.

D. Minimum Respiratory Protection: Shall be a ½-mask negative pressure air purifying respirator equipped with P100 filters, provided personal air samples in the workplace remain at or below 0.1 f/cc, determined as an 8-hour TWA. Full face powered air purifying respirator equipped with P100 filters shall be required until Contractor demonstrates that personal air samples are at or below 0.1 f/cc, determined as an 8-hour TWA. A higher level of respiratory protection shall be required, if fiber levels exceed 1 f/cc as an 8-hour TWA, inside the regulated work area. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h) and 29 CFR 1910.134 (d)(3)(i)(A) Table 1, except as indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

E. Medical Written Opinion: No employee shall be allowed to wear a respirator unless a physician or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

F. Respirator Fit Test: All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

G. Respirator Fit Check: The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from entering the regulated area until resolution of the problem.

H. Maintenance and Care of Respirators: The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) Maintenance and Care of Respirators.

I. Supplied Air Systems: If a supplied air system is used, the system shall meet all requirements of 29 CFR 1910.134 and the ANSI/Compressed Gas Association (CGA) Commodity Specification for Air current requirements for Type 1 - Grade D breathing air. Low pressure systems are not allowed to be used on asbestos abatement projects. Supplied Air respirator use shall be in accordance with EPA/NIOSH publication EPA-560-OPTS-86-001 "A Guide to Respiratory Protection for the Asbestos Abatement Industry". The competent person on site will be responsible for the supplied air system to ensure the safety of the worker.

1.8 WORKER PROTECTION

A. Training of Abatement Personnel: Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

B. Medical Examinations: Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion that the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

C. Regulated Area Entry Procedure: The Competent Person shall ensure that each time workers enter the regulated area; they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

D. Decontamination Procedure: The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

1. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.
2. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to avoid inhaling asbestos fibers while showering. The following procedure is required as a minimum:
   a. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
   b. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
   c. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.
3. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside

of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction. **(THIS PROCEDURE IS NOT A SUBSTITUTE FOR RESPIRATOR CLEANING!)**

4. Shower and wash body completely with soap and water. Rinse thoroughly.
5. Rinse shower room walls and floor to drain prior to exiting.
6. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

E. Regulated Area Requirements: The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

A. Description: Provide each regulated area with separate personnel decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

B. General Requirements: All personnel entering or exiting a regulated area must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6-mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6-mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weight inner doorway sheets with layers of duct tape or approved equivalent so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting and reduce potential for non-authorized personnel entering the regulated area.

C. Temporary Facilities to the PDF and W/EDF: The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at

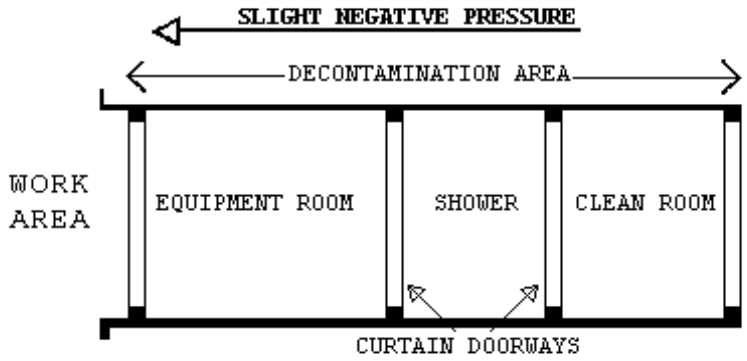
the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat, if needed, to maintain 70 degrees F throughout the PDF and W/EDF.

D. Personnel Decontamination Facility (PDF): The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room which is connected to the regulated area. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to insure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 3 layers of 6-mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6-mil poly opaque fire retardant doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry and sanitary condition. Shower overflow shall not be allowed into the clean room. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Male/Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male/female can enter or exit the PDF during his/her stay in the PDF.
2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room

to the equipment room and for the showering of all personnel going from the equipment room to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using air tight walls made from at least 3 layers of 6-mil opaque fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Waste water will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.

3. Equipment Room: The Competent Person shall provide an equipment room which shall be an air tight compartment for the storage of work equipment/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The Competent Person shall ensure that most gross contamination is removed from the outside of PPE, suits and respirators in the regulated work area, prior to entering the Equipment Room. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6-mil opaque fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by air tight walls and ceiling constructed of a minimum of 3 layers of 6-mil opaque fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6-mil fire retardant poly per shift change and remove this layer after each shift. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
4. The PDF shall be as follows: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF shall be a minimum of 2 layers of 6-mil opaque fire retardant poly.

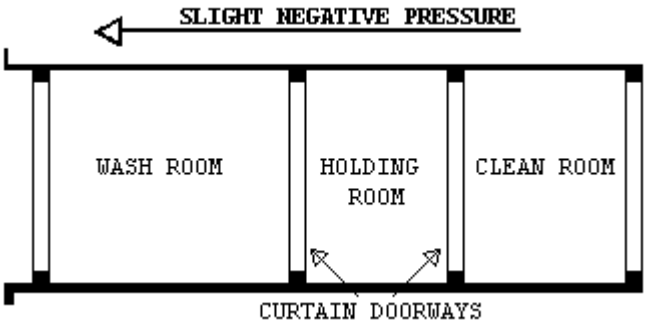


E. Waste/Equipment Decontamination Facility (W/EDF):

1. The Competent Person shall provide a W/EDF consisting of a wash room, holding room, and clean room for removal of waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:
   a. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Wash Room as an equipment bag and container cleaning station.
   b. Wash Room: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the wash room using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3 layers of 6-mil fire retardant poly. Locate the wash room so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the wash room shall be constructed of 2 layers of 6-mil fire retardant poly.
   c. Holding Room: Provide a holding room as a drop location for bagged materials passed from the wash room. Construct the holding room using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3 layers of 6-mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the wash room to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6-mil fire retardant poly.

d. Clean Room: Provide a clean room to isolate the holding room from the exterior of the regulated area. Construct the clean room using 2 inches x 4 inches wood framing or approved equivalent and 2 layers of 6-mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of 2 layers of 6-mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.

e. The W/EDF shall be as follows: Wash Room leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



F. Waste/Equipment Decontamination Procedures: At the washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Wash Room after visual inspection. When passing anything into the Wash Room, close all doorways of the W/EDF, other than the doorway between the washdown station and the Wash Room. Keep all outside personnel clear of the W/EDF. Once inside the Wash Room, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. At no time shall personnel from the clean side be allowed to enter the Wash Room.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General Requirements: Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have

been delivered to the site and the CPIH/CIH has submitted verification to the VA's representative.

1. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
2. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated area until abatement is completed.
3. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized location.
4. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
5. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
6. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the VA and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of moisture resistant duct tape, poly tape, furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or approved equivalent procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
7. Polyethylene sheeting utilized for the PDF shall be opaque white or black in color, 6-mil fire retardant poly.
8. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and waste water filtration system shall be provided by the Contractor.
9. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements, fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools,

materials or equipment required to conduct the abatement project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.

10. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water and falling material).
11. Disposal bags – 2 layers of 6-mil poly for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
12. The VA shall be provided an advance copy of the Safety Data Sheets (SDS) as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-start meeting submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.
13. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.
14. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 MONITORING, INSPECTION AND TESTING

A. General:

1. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications. In addition, the CPIH/CIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples inside the building, but outside the regulated area. Inside the building, but outside the regulated area air samples shall be collected in the Clean Room of the PDF, at the approximate location of HEPA exhaust discharge, and at a minimum of three (3) locations in areas immediately outside the regulated work area to satisfy this specification. Additional inspection and testing requirements are also indicated in other parts of this specification.

2. The VA will employ an independent industrial hygienist (VPIH/CIH) consultant and/or use its own IH to perform various services on behalf of the VA. The VPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that VA patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the VPIH/CIH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified. The cost of the VPIH/CIH and their services will be borne by the VA except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.
3. If fibers counted by the VPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the VA's representative. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. Confirmation sampling and analysis will be the responsibility of the CPIH/CIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH and the VPIH/CIH shall be reached on the exact details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed by the IH's and delivered to the VA's representative.

B. Scope of Services of the VPIH/CIH Consultant:

1. The purpose of the work of the VPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or

building has been adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM. The VPIH/CIH will perform the following tasks:

a. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
b. Task 2: Perform representative air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
c. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
d. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
e. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.
f. Task 6: Issue certificate of decontamination for each regulated area and project report.

2. All documentation, inspection results and testing results generated by the VPIH/CIH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the VPIH/CIH for efficient and smooth performance of their work.
3. The monitoring and inspection results of the VPIH/CIH will be used by the VA to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

C. Monitoring, Inspection and Testing by Contractor CPIH/CIH: The Contractor's CPIH/CIH is responsible for managing all monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH/CIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of the Contractor's personnel. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the Contractor/Competent Person. The person performing the personnel and area air monitoring inside the regulated

area shall be an IH Technician, who shall be trained and shall have specialized field experience in sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytical Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA AHERA/State Contractor/Supervisor and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples and have experience in substantially similar projects in size and scope. The analytical laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for personal and area air monitoring for asbestos in 29 CFR 1926.1101(f), (g) and Appendix A. This log shall be made available to the VA representative and the VPIH/CIH upon request. The log will contain, at a minimum, information on personnel or area samples, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH/CIH shall collect and analyze samples for each representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two (2) personal air samples or 25 percent of representative workforce per shift shall be collected, whichever is greater, in the regulated area; a minimum of three (3) area air samples at locations inside the building but immediately outside the regulated work area; one (1) area air sample shall be collected daily in the Clean Room of the PDF; and one (1) area air sample shall be collected daily at the approximate location of HEPA exhaust discharge. In addition to the continuous monitoring required, the CPIH/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.3 ASBESTOS HAZARD ABATEMENT PLAN

A. The Contractor shall have an established an Asbestos Hazard Abatement Plan (AHAP) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the procedures to be followed during all phases of the work by the Contractor's personnel. The AHAP must be modified as needed to address

specific requirements of this project and the specifications. The AHAP shall be submitted for review and approval to the VA prior to the start of any abatement work. The minimum topics and areas to be covered by the AHAPs are:

1. Minimum Personnel Qualifications
2. Emergency Action Plan/Contingency Plans and Arrangements
3. Security and Safety Procedures
4. Respiratory Protection/Personal Protective Equipment Program and Training
5. Medical Surveillance Program and Recordkeeping
6. Regulated Area Requirements - Containment Barriers/Isolation of Regulated Area
7. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
8. Negative Pressure Systems Requirements
9. Monitoring, Inspections, and Testing
10. Removal Procedures for ACM
11. Removal of Contaminated Soil (if applicable)
12. Encapsulation Procedures for ACM
13. Disposal of ACM waste/equipment
14. Regulated Area Decontamination/Clean-up
15. Regulated Area Visual and Air Clearance
16. Project Completion/Closeout

2.4 SUBMITTALS

A. Pre-Start Meeting Submittals:

1. Submit to the VA a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project:
   a. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
   b. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.

c. Submit Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.

d. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:

   1)Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.

   2)Waste water filtration system, shower system, containment barriers.

   3)Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.

   4)Respirators, protective clothing, fall protection and other required personal protective equipment.

   5)Fire safety equipment to be used in the regulated area.

e. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.

f. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.

g. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.

h. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.

1)Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project: Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date

2)List of project(s) halted by owner, A/E, IH, regulatory agency in the last 3 years: Project Name; Reason; Date; Reference Name/Number; Resolution

3)List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including the company's officers (including damages paid) in the last 3 years. Provide copies and all information needed for verification.

i. Submit information on personnel: Provide a resume; address each item completely; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and that the company has implemented a medical surveillance program and written respiratory protection program, and maintains recordkeeping in accordance with the above regulation. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

1)CPIH/CIH and IH Technician: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; medical opinion; and current respirator fit test.

2)Competent Person(s)/Supervisor(s): Number; names; last four digits of social security numbers; years of abatement experience as Competent Person/Supervisor; list of similar projects in size/complexity as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

3)Workers: Numbers; names; last four digits of social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

j. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHAPs incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; and copies of monitoring results of the five referenced projects listed and analytical methods used.

k. Rented equipment must be decontaminated prior to returning to the rental agency.

l. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all SDS and application instructions.

B. Submittals During Abatement:

1. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as barrier breeching, equipment failures, emergencies, and any cause for stopping work; and representative air monitoring and results/TWA's/EL's. Submit this information daily to the VA's representative.

2. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.

   a. Removal of any poly barriers.

   b. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.

   c. Packaging and removal of ACM waste from regulated area.

   d. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's representative on a weekly basis.

C. Submittals at Completion of Abatement: The CPIH/CIH shall submit a project report consisting of the daily log book requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of

completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

A. Site Security:

1. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and representatives, State and Local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.
2. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately require any unauthorized person to leave the regulated area and then notify the VA Contracting Officer or VA Representative using the most expeditious means.
3. A log book shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
4. Access to the regulated area shall be through a single decontamination unit. All other access (doors, windows, hallways, etc.) shall be sealed and demarcated as an asbestos regulated work area to prevent entry to or exit from the regulated area unless in the event of an emergency. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside; however, they shall be sealed with poly sheeting and taped until needed. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.
5. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24-hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.

6. The Contractor will have the VA's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by the VA's employees.
7. The regulated area shall be locked during non-working hours and secured by VA Representative or Competent Person. The VA Police shall be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

B. Signage and Power Management:

1. Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.
2. Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.
3. Shut down and lock out/tag out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the VA's representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of independently installed 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil polyethylene disposal bags for staging and eventual disposal as asbestos waste.

C. Negative Pressure Filtration System:

1. The Contractor shall provide enough HEPA negative air machines to effect $\geq$ - 0.02 inch WCG pressure differential inside the regulated work area. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to effect $\geq$ - 0.02 inch WCG pressure inside the regulated work area. Provide standby units in the event of machine failure and/or emergency in an adjacent area. HEPA equipped negative air machines shall be discharged

outside of the building a minimum of 30 feet from building make-up air, doors, open windows, patients, visitors and staff.

2. NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50 percent efficiency. The contractor shall consider this in their determination of number of units needed to provide ≥ - 0.02 inch WCG pressure differential inside the regulated work area. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2 inches pressure drop across the filters.
3. Design and Layout:
   a. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:
      1)Method of supplying power to the units and designation/location of the panels.
      2)Description of testing method(s) for correct air volume and pressure differential.
      3)If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.
4. Negative Air Machines (Hepa Units):
   a. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30 inches in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
   b. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.
   c. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to

form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97 percent. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

d. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 µm or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 µm or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.

e. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for various pressure readings on the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.

f. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.

g. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.

h. It is essential that replacement HEPA filters be tested using an “in-line” testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and

be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters.

5. Pressure Differential: The fully operational negative air system within the regulated area shall continuously maintain a pressure differential ≥ - 0.02 inch WCG inside the regulated work area. Before any disturbance of any asbestos material, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(g)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.
6. Monitoring: The pressure differential shall be continuously monitored and recorded between the regulated area and the area outside the regulated area with a monitoring device that incorporates a strip chart recorder. The strip chart recorder shall become part of the project log and shall indicate at least ≥ - 0.02 inch WCG pressure differential inside the regulated work area for the duration of the project.
7. Auxiliary Generator: If the building is occupied during abatement, provide an auxiliary gasoline/diesel generator located outside the building in an area protected from the weather. In the event of a power failure of the general power grid and the VAMC emergency power grid, the generator must automatically start and supply power to a minimum of 50 percent of the negative air machines in operation.
8. Supplemental Make-Up Air Inlets: Provide, as needed for proper air flow in the regulated area, in a location approved by the VA, openings in the plastic sheeting to allow outside air to flow into the regulated area. Auxiliary makeup air inlets must be located as far from the negative air machines as possible, off the floor near the ceiling, and away from the barriers that separate the regulated area from the occupied clean areas. Cover the inlets with weighted flaps which will seal in the event of failure of the negative pressure system.
9. Testing The System: The negative pressure system must be tested before any ACM is disturbed in any way. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the VA using smoke tubes and a negative pressure gauge. Verification and documentation of adequate negative pressure differential across each barrier must be done at the start of each work shift.

10. Demonstration of the Negative Pressure Filtration System:
    a. The demonstration of the operation of the negative pressure system to the VA shall include, but not be limited to, the following:
        1) Plastic barriers and sheeting move lightly in toward the regulated area.
        2) Curtains of the decontamination units move in toward regulated area.
        3) There is a noticeable movement of air through the decontamination units. Use the smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room to the regulated area.
        4) Use smoke tubes to demonstrate air is moving across all areas in which work is to be done. Use a differential pressure gauge to indicate a negative pressure of at > -0.02 inch across every barrier separating the regulated area from the rest of the building. Modify the system as necessary to meet the above requirements.
11. Use of the Negative Pressure Filtration System During Abatement Operations:
    a. Start units before beginning any disturbance of ACM occurs. After work begins, the units shall run continuously, maintaining 4 actual air changes per hour at a negative pressure differential of > - 0.02 inch water column gauge, for the duration of the work until a final visual clearance and final air clearance has been successfully completed.
    b. No negative air units shall be shut down at any time unless authorized by the VA Contracting Officer, verbally and in writing.
    c. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.
    d. Abatement work shall begin at a location farthest from the units and proceed towards them. If an electric failure occurs, the Competent Person shall stop all abatement work and immediately begin wetting all exposed asbestos materials for the duration of the power outage. Abatement work shall not resume until power is restored and all units are operating properly again.
    e. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air clearance has been successfully completed for that regulated area.

12. Dismantling The System: After completion of the final visual and final air clearance has been obtained by the VPIH/CIH, the units may be shut down. The unit exterior surfaces shall have been completely decontaminated; pre-filters are not to be removed and the units inlet/outlet sealed with 2 layers of 6-mil poly immediately after shut down. No filter removal shall occur at the VA site following successful completion of site clearance. OSHA/EPA/DOT asbestos labels shall be attached to the units.

D. Containment Barriers and Coverings in the Regulated Area:

1. General: Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, Contractor shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.
2. Preparation Prior To Sealing: The Regulated Area: Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects not scheduled for removal remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.
3. Controlling Access to The Regulated Area: Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA DANGER demarcation signs posted as required by OSHA. If the regulated area is adjacent to, or within view of an occupied area, provide a visual barrier of 6-mil opaque fire retardant poly to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.
4. Critical Barriers: Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6-mil fire retardant poly and duct tape. Individually seal with 2 layers of 6-mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other

objects/openings in the regulated area. Heat must be shut off any objects covered with poly.

5. Primary Barriers:
   a. Cover the regulated area with two layers of 6-mil fire retardant poly on the floors and two layers of 4 mil, fire retardant poly on the walls, unless otherwise directed in writing by the VA representative. Floor layers must form a right angle with the wall and turn up the wall at least 300 mm (12 inches). Seams must overlap at least 1800 mm (6 feet) and must be spray glued and taped. Install sheeting so that layers can be removed independently from each other. Carpeting shall be covered with three layers of 6-mil poly. Corrugated cardboard sheets must be placed between the bottom and middle layers of poly. Mechanically support and seal with duct tape and glue all wall layers.
   b. If stairs and ramps are covered with 6-mil plastic, two layers must be used. Provide 19 mm (3/4 inch) exterior grade plywood treads held in place with duct tape/glue on the plastic. Do not cover rungs or rails with any isolation materials.
6. Secondary Barriers: A loose layer of 6-mil shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work.
7. Extension of the Regulated Area: If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.
8. Firestopping:
   a. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. must be firestopped with a fire-rated firestop system providing an air tight seal.
   b. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the VA Representative. The contractor shall list all areas of penetration, the type of sealant used, and whether or not the location is fire rated. Any discovery of penetrations during abatement shall be brought to the attention of the VA representative immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the VA Representative or Fire Marshall.
   c. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the VA Representative for a sealant system determination. Firestops shall

meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

E. Sanitary Facilities: The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

F. Personal Protective Equipment: Provide whole body clothing, head coverings, gloves and foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

G. Pre-Cleaning: Not sure if this section is needed as contamination was not identified. No materials were damaged to cause contamination.

1.

2. Pre-clean all surfaces in the regulated area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

H. Pre-Abatement Activities:

1. Pre-Abatement Meeting: The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH/CIH, Competent Person(s), the VA representative(s), and the VPIH/CIH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the VA's representative regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the VA's representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the VA written order to proceed.

2. Pre-Abatement Construction and Operations:

a. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.

b. Upon completion of all preparatory work, the CPIH/CIH will inspect the work and systems and will notify the VA's representative when the work is completed in accordance with this specification. The VA's representative may inspect the regulated area and the systems with the VPIH/CIH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.

c. The CPIH/CIH shall document the pre-abatement activities described above and deliver a copy to the VA's representative.

d. Upon satisfactory inspection of the installation of and operation of systems, the VA's representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification and all applicable regulations.

3. Pre-Abatement Inspections and Preparations:

a. Before any work begins on the construction of the regulated area, the Contractor will:

1)Conduct a space-by-space inspection with an authorized VA representative and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.

2)A NESHAP (destructive) ACM inspection shall be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawlspaces (previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line

trench coverings. Verify during NESHAP survey that no other suspect ACM is present.

3) Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed from the regulated area have been cleaned and removed or properly protected from contamination.

4)If present and required, remove and dispose of carpeting from floors in the regulated area.

5)Inspect existing firestopping in the regulated area. Correct as needed.

3.2 REMOVAL OF ACM

A. Wetting ACM:

1. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP regulation and OSHA's "wet methods" for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the VA's representative.
2. Amended Water: Provide water to which a surfactant has been added to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting of one ounce of 50 percent polyoxyethylene ester and 50 percent polyoxyethylene ether mixed with 5 gallons (19L) of water.

B. Secondary Barrier and Walkways:

1. Install as a drop cloth a 6-mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely cover floors and any walls within 10 feet (3 meters) of the area where work is to done. Secure the secondary barrier with duct tape to prevent it from moving or debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wetted. When removing, fold inward to prevent spillage and place in a disposal bag.
2. Install walkways using 6-mil black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

C. Wet Removal of ACM:

1. Adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by VA, removal encapsulant to reduce/prevent fiber release to the air. Adequate time must be allowed for the amended water or removal encapsulant to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet to the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer's written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully remove covering while wetting to minimize fiber release. **In no event shall dry removal occur except when authorized in writing by the VPIH/CIH and VA when a greater safety hazard (e.g., electricity) is present**.
2. If ACM does not wet well with amended water due to composition, coating or jacketing, remove as follows:
   a. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
   b. Remove saturated ACM in small sections. Do not allow material to dry out. As material is removed, bag material, while still wet into disposal bags. Twist the bag neck tightly, bend over (gooseneck) and seal with a minimum of three tight wraps of duct tape. Clean /decontaminate the outside of the bag of any residue and move to washdown station adjacent to W/EDF.

D.

3.3 LOCKDOWN ENCAPSULATION

A. General: Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, the contractor shall encapsulate all surfaces with a bridging encapsulant.

B. Delivery and Storage: Deliver materials to the job site in original, new and unopened containers bearing the manufacturer's name and label as well as the following information: name of material, manufacturer's stock number, date of manufacture, thinning instructions, application instructions and the SDS for the material.

C. Worker Protection: Before beginning work with any material for which an SDS has been submitted, provide workers with any required personal protective equipment. The required personal protective equipment shall be used whenever exposure to the material might occur. In addition to OSHA/specification requirements for respiratory protection, a paint pre-filter and an organic vapor cartridge, at a minimum, shall be used in addition to the HEPA filter when an organic solvent based encapsulant or other solvent is used. The CPIH/CIH shall be responsible for provision of adequate respiratory protection. Note: Flammable and combustible encapsulants or solvents shall not be used, unless authorized in writing by the VA.

D. Encapsulation of Scratch Coat Plaster or Piping:

1. Apply two coats of lockdown encapsulant to the scratch coat plaster or piping after all ACM has been removed. Apply in strict accordance with the manufacturer's instructions. Any deviation from the instructions must be approved by the VA's representative in writing prior to commencing the work.
2. Apply the lockdown encapsulant with an airless sprayer at a pressure and using a nozzle orifice as recommended by the manufacturer. Apply the first coat while the scratch coat is still damp from the asbestos removal process, after passing the visual inspection. If the surface has been allowed to dry, wet wipe or HEPA vacuum prior to spraying with encapsulant. Apply a second coat over the first coat in strict conformance with the manufacturer's instructions. Color the lockdown encapsulant and contrast the color in the second coat so that visual confirmation of completeness and uniform coverage of each coat is possible. Adhere to the manufacturer's instructions for coloring. At the completion of the encapsulation, the surface must be a uniform third color produced by the mixture.

E. Sealing Exposed Edges: Seal edges of ACM exposed by removal work which is inaccessible, such as a sleeve, wall penetration, etc., with two coats of bridging encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the bridging encapsulant. Apply in accordance with 3.3.4 (B).

3.4 DISPOSAL OF ACM WASTE MATERIALS

A. General: Dispose of waste ACM and debris which is packaged in accordance with these specifications, in accordance with OSHA, EPA, State, Local and DOT requirements. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR

171-180 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

B. Procedures:

1. The VA must be notified at least 24 hours in advance of any waste removed from the containment.
2. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures is this specification. Waste shall be double-bagged and wetted with amended water prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be evacuated with HEPA vacuum and securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goose necked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
3. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and HEPA vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped and HEPA vacuumed.
4. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.5 PROJECT DECONTAMINATION

A. General:

1. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
2. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleanings of the surfaces of the regulated area after the primary barrier removal.

3. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.

B. Regulated Area Clearance: Clearance air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

C. Work Description: Decontamination includes the clearance air testing in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities, and negative pressure systems.

D. Pre-Decontamination Conditions:

1. Before decontamination starts, all ACM waste from the regulated area shall be collected and removed, and the loose 6-mil layer of poly removed while being adequately wetted with amended water and disposed of along with any gross debris generated by the work.
2. At the start of decontamination, the following shall be in place:
   a. Primary barriers consisting of 2 layers of 6-mil poly on the floor and 4 mil poly on the walls.
   b. Critical barriers consisting of 2 layers of 6-mil poly which is the sole barrier between the regulated area and openings to the rest of the building or outside.
   c. Decontamination facilities for personnel and equipment in operating condition and the negative pressure system in operation.

E. First Cleaning: Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and HEPA vacuuming. Do not use dry dusting/sweeping/air blowing methods. Use each surface of a wetted cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

F. Pre-Clearance Inspection and Testing: The CPIH/CIH and VPIH/CIH will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any

visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the VA's representative of the results with a brief report from the CPIH/CIH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation. The VA reserves the right to utilize their own VPIH/CIH to perform a pre-clearance inspection and testing for verification.

G. Lockdown Encapsulation of Abated Surfaces: With the express written permission of the VA's representative, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification. Negative pressure shall be maintained in the regulated area during the lockdown application.

3.6 FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING

A. General: Notify the VA representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the VPIH/CIH starting after the final cleaning.

B. Final Visual Inspection: Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no additional cost to the VA. Dust/material samples may be collected and analyzed at no additional cost to the VA at the discretion of the VPIH/CIH to confirm visual findings. When the regulated area is visually clean the final testing can be done.

C. Final Air Clearance Testing:

1. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of two field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA presented in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor**.

2. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

D. Final Air Clearance Procedures:

1. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured by the AHERA PCM protocol and < 70 AHERA asbestos structures per square millimeter (s/mm2) by AHERA TEM. No averaging of results will be used for this project. All five (5) TEM samples inside the regulated area shall be at or below 70 asbestos s/mm2 to satisfy the project final clearance criteria.
2. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the VPIH/CIH will secure samples and analyze them according to the following procedures:
   a. Fibers Counted: “Fibers” referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the AHERA TEM method.
   b. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques except where soil is not encapsulated or enclosed. Samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ MCE for TEM. A minimum of 3850 Liters of air using calibrated sampling pumps shall be collected for PCM samples and a minimum of 1200 Liters of air using calibrated sampling pumps shall be collected for TEM clearance samples. Before pumps are started, initiate aggressive air mixing sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off. The negative pressure system shall continue to operate.

E. Clearance Sampling Using PCM – Less than 260LF/160SF:

1. The VPIH/CIH will perform clearance samples as indicated by the specification.
2. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 3850 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc to clear the regulated area.

F. Clearance Sampling Using Tem – Equal to or more than 260LF/160SF: TEM

1. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.
2. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm2) AHERA TEM, no averaging of results for this specific project.

G. Laboratory Testing of PCM Clearance Samples: The services of an AIHA accredited laboratory will be employed by the VA to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily by the VPIH/CIH so that verbal/faxed reports can be received within 24-36 hours. A complete record, certified by the laboratory, of all air monitoring tests and results will be furnished to the VA's representative and the Contractor.

H. Laboratory Testing of Tem Samples: Samples shall be sent by the VPIH/CIH to a NIST NVLAP accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. Verbal/faxed results from the laboratory shall be available within 24-36 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the VA's representative and the Contractor.

I. Laboratory Testing of Bulk Samples: Samples shall be sent by the VPIH/CIH or CPIH/CIH to a NIST NVLAP accredited laboratory for analysis by PLM. The laboratory shall successfully participate in the NIST NVLAP Bulk Asbestos Analysis (PLM) program. Verbal/faxed results from the laboratory shall be available within 24-36 hours after receipt of the samples. A complete record, certified by the laboratory, of all PLM and/or TEM results shall be furnished to the VA's representative and the Contractor.

3.7 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

A. Completion of Abatement Work:

1. After thorough decontamination, seal negative air machines with 2 layers of 6-mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area. Complete asbestos abatement work upon meeting the regulated area visual and air clearance criteria and fulfilling the following:
   a. Remove all equipment and materials from the project area.
   b. Dispose of all packaged ACM waste as required.

c. Repair or replace all interior finishes damaged during the abatement work, as required.

d. Fulfill other project closeout requirements as required in this specification.

B. Certificate of Completion By Contractor: The CPIH/CIH shall complete and sign the "Certificate of Completion" in accordance with Attachment 1 at the completion of the abatement and decontamination of the regulated area.

C. Work Shifts: All work shall generally be done during administrative hours (8:00 AM to 4:30 PM) Monday - Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the VA Representative.

ATTACHMENT #1
CERTIFICATE OF COMPLETION

DATE: _____ VA Project #:_____

PROJECT NAME:_____ Abatement Contractor:_____

VAMC/ADDRESS:_____

1. I certify that I have personally inspected, monitored and supervised the abatement work of (specify regulated area or Building):
   which took place from / / to / /
2. That throughout the work all applicable requirements/regulations and the VA's specifications were met.
3. That any person who entered the regulated area was protected with the appropriate personal protective equipment and respirator and that they followed the proper entry and exit procedures and the proper operating procedures for the duration of the work.
4. That all employees of the Abatement Contractor engaged in this work were trained in respiratory protection, were experienced with abatement work, had proper medical surveillance documentation, were fit-tested for their respirator, and were not exposed at any time during the work to asbestos without the benefit of appropriate respiratory protection.
5. That I performed and supervised all inspection and testing specified and required by applicable regulations and VA specifications.
6. That the conditions inside the regulated area were always maintained in a safe and healthy condition and the maximum fiber count never exceeded 0.5 f/cc, except as described below.
7. That all abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date:_____

CPIH/CIH Print Name:_____

Abatement Contractor Signature/Date:_____

Abatement Contractor Print Name:_____

ATTACHMENT #2
CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME:_____DATE:_____

PROJECT ADDRESS:_____

ABATEMENT CONTRACTOR'S NAME:_____

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate of worker's acknowledgement you are indicating to the owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32-hours minimum duration. I currently have a valid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

Physical Characteristics and Background Information on Asbestos
Potential Health Effects Related to Exposure to Asbestos
Employee Personal Protective Equipment
Establishment of a Respiratory Protection Program
State of the Art Work Practices
Personal Hygiene
Additional Safety Hazards
Medical Monitoring
Air Monitoring
Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature:_____

Printed Name:_____

Social Security Number:_____

Witness:_____

ATTACHMENT #3
AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND TRAINING/ACCREDITATION

VA PROJECT NAME AND NUMBER:_____

VA MEDICAL FACILITY:_____

ABATEMENT CONTRACTOR'S NAME AND ADDRESS:_____

1. I verify that the following individual

Name:_____ Social Security Number:_____

who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

Address:_____

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.

3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.

4. I verify that I meet the minimum qualifications criteria of the VA specifications for a CPIH.

Signature of CPIH/CIH:_____ Date:_____

Printed Name of CPIH/CIH:_____

Signature of Contractor:_____ Date:_____

Printed Name of Contractor:_____

ATTACHMENT #4
ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE VA'S ASBESTOS SPECIFICATIONS

VA Project Location:_____

VA Project #:_____

VA Project Description:_____

1. This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the VA related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

2 I, the undersigned, have read VA's Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the VA's Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the VA's Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the VA's Asbestos Specification.

3. At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the VA's Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner's Signature_____Date_____

- - - E N D - - -

SECTION 02 82 13.19
ASBESTOS FLOOR TITLE AND MASTIC ABATEMENT

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

A. Contract Documents and Related Requirements: Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

B. Extent of Work:

1. Below is a brief description of the estimated quantities of asbestos flooring materials to be abated. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy himself as to the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
2. Removal, clean-up and disposal of asbestos containing materials (ACM) and asbestos/waste contaminated elements or debris in an appropriate regulated area for the following approximate quantities;
   (2100) square feet of flooring and mastic.
   (375) square feet of carpet material.

C. Related Work:

1. Section 07 84 00, FIRESTOPPING
2. Division 09, FINISHES

3. Division 22, PLUMBING

D. Tasks:

1. The work tasks are summarized briefly as follows:

   a. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and Asbestos Hazard Abatement Plans for asbestos work.

   b. Abatement activities including removal, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.

   c. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

E. Abatement Contractors Use of Premises:

1. The Contractor and Contractor's personnel shall cooperate fully with the VA representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the VA specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State and Local regulations and requirements.

2. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved VA Design and Construction Procedures. VA Design Construction Procedure drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing from the VA Representative through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings.

1.2 VARIATIONS IN QUANTITY

A. The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. Accordingly, minor variations (+/- 10 percent) in quantities of ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required

beyond the above variation, the contractor shall provide unit prices for newly discovered ACM and those prices shall be used for additional work required under the contractor.

1.3 STOP ASBESTOS REMOVAL

A. If the Contracting Officer; their field representative; the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. Work stoppage will continue until conditions have been corrected to the satisfaction of the VA. Standby time and costs for corrective actions will be borne by the Contractor, including the VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities if:

1. Airborne PCM analysis results equal to or greater than 0.01 f/cc above background levels inside the building but outside the regulated area;
2. breach or break in regulated area containment barrier(s);
3. less than –0.02 inch WCG pressure in the regulated area;
4. serious injury/death at the site;
5. fire/safety emergency at the site;
6. respiratory protection system failure;
7. power failure or loss or inadequate use of wetting agent;
8. any visible emissions observed outside the regulated area; or
9. failure to follow project specification requirements.

1.4 DEFINITIONS

A. General: Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents, but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

B. Glossary:

Abatement - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aerosol - Solid or liquid particulate suspended in air.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive air sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 3, Fifth Edition is used to determine the fiber levels in air. For personal samples, area air samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis, the NIOSH Method 7402 (Issue 2, Fourth Edition) can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester (MCE) membrane for PCM (Phase Contrast Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.8 micron pore size) and MCE for TEM (Transmission

Electron Microscopy, 25 mm, 3-piece with 2 inches Static Extension Cowl, 0.45 micron pore size).

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

Asbestos-containing material (ACM) - Any material containing more than one percent of asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-contaminated soil (ACS) – Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

Asbestos-containing waste (ACW) material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos Project Monitor – Some states require that any person conducting asbestos abatement air sampling, clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the VA, the Contractor, or government agency and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the VA; the contractor; or any government agency representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of 2-layers of 6-mil independently installed plastic sheeting (Polyethylene) secured in place at openings such as doors, windows, penetrations or any other opening into the regulated area.

Primary Barrier – Plastic barriers placed over critical barriers and exposed directly to abatement work or to secondary barrier.

Secondary Barrier - Any additional plastic barriers used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - A person certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the VA's Professional Industrial Hygiene consultant/Certified Industrial Hygienist (VPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may report to a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace – An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Disposal bag - Typically 6-mil thick sift-proof, dustproof, leak-tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance – Asbestos Operations and Maintenance Activities (OSHA Class III) that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag, which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift-proof, dustproof, and leak-tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an air tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width (aspect) ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure in order to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than one (1) percent asbestos as determined using the method specified in 40 CFR 763, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter – An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

HEPA vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist (IH) - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician (IH Technician) - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned. Some states require that an industrial hygienist technician conducting asbestos abatement air sampling, clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL or Excursion Limit (EL).

Negative pressure - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02 inch water column gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air pressure outside the respirator facepiece.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators to remove organic vapor hazardous air contaminants.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for as an eight (8) hour time-weighted average (TWA). For asbestos fibers, the eight (8) hour time-weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit (EL) is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) – equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, fall protection, and respirators.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or more workers within the regulated area using a filter cassette and a calibrated air sampling pump to determine asbestos exposure.

Pipe tunnel – An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, debris or asbestos-contaminated soil.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6-mils thick, semi-transparent, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator, respectively.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge, or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (k)(5).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of

four projects of similar complexity with this project of which at least three projects serving as the supervisory IH. The PIH may be either the VA's PIH (VPIH/CIH) or Contractor's PIH (CPIH/CIH).

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Subpart E, Appendix C, Part I; (B)(5).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-2018.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, decorative, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

VA Professional Industrial Hygienist (VPIH/CIH) – The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may report to a Certified Industrial Hygienist (CIH).

VA Representative - The VA official responsible for on-going project work.

VA Total – means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM/ACS or ACM waste material.

Waste/Equipment decontamination facility (W/EDF) – The area in which equipment is decontaminated before removal from the regulated area.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

C. Referenced Standards Organizations: See Section 01 42 19 REFERENCED STANDARDS.

1.5 APPLICABLE CODES AND REGULATIONS

A. General Applicability of Codes, Regulations, and Standards:

1. All work under this contract shall be done in strict accordance with all applicable Federal, State, and Local regulations (agreed), standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
2. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.
3. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system and/or the Contractor's on-site Field Office. These standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 may be made available electronically.

B. Contractor Responsibility: The Asbestos Abatement Contractor (Contractor) shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE), including respiratory protection and respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The Contractor will incur all costs of the CPIH/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State/Local requirements related to failure to comply with the regulations applicable to the work.

C. Federal Requirements:

1. Federal requirements which govern asbestos abatement include, but are not limited to, the following regulations:
   a. Occupational Safety and Health Administration **(OSHA)**
      1) Title 29 CFR 1926.1101 - Construction Standard for Asbestos
      2) Title 29 CFR 1926 Subpart E - Personal Protective Equipment and Life Saving Equipment
      3) Title 29 CFR 1910.134 - Respiratory Protection

4)Title 29 CFR 1926 - Construction Industry Standards

5)Title 29 CFR 1926.33 - Access to Employee Exposure and Medical Records

6)Title 29 CFR 1926.59 same as 1910.1200 - Hazard Communication

7)Title 29 CFR 1926 Subpart C – General Safety and Health Provisions and Subpart D – Occupational Health and Environmental Controls

b. Environmental Protection Agency **(EPA)**:

1)40 CFR 61 Subpart M - National Emission Standard for Hazardous Air Pollutants - Asbestos.

2)40 CFR 763 - Asbestos Hazard Emergency Response Act (AHERA) and Asbestos Hazard Abatement Reauthorization Act (ASHARA)

c. Department of Transportation **(DOT)**

1)Title 49 CFR 171 - 180 – Transportation

D. State Requirements:

1. State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, The Vermont Department of Health Title 18, Chapter 26.

E. Local Requirements:

1. If local requirements are more stringent than federal or state standards, the local standards are to be followed.

F. Standards:

1. Standards which govern asbestos abatement activities include, but are not limited to, the following:

a. American National Standards Institute (ANSI)/ASSP Z9.2-2018 - Fundamentals Governing the Design and Operation of Local Exhaust Systems and ANSI/ASSE Z88.2-2015 - Practices for Respiratory Protection.

b. Underwriters Laboratories (UL) 586-2009 - UL Standard for Safety of HEPA Filter Units, 9th Edition; ANSI Approval 2017-12-19.

2. Standards which govern encapsulation work include, but are not limited to the following:

a. American Society for Testing and Materials International (ASTM)

3. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:

a. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

b. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.

c. NFPA 101 - Life Safety Code

G. EPA Guidance Documents:

1. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference.
2. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
3. Asbestos Waste Management Guidance EPA 530-SW-85-007
4. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001
5. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

H. Notices:

1. State and Local agencies: Send written notification as required by State and Local regulations prior to beginning any work on ACM as outlined in the Vermont Department of Health Title 18, Chapter 26.
2. Copies of notifications shall be submitted to the VA for the facility's records in the same time frame notification are given to EPA, State, and Local regulations prior to beginning any work on ACM as follows.

I. Permits/Licenses: The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

J. Posting and Filing of Regulations: Maintain two (2) copies of applicable Federal, State, and Local regulations. Post one copy of each at the regulated area where workers will have daily access to the regulations and keep another hard copy or electronic copy in the Contractor's office.

K. VA Responsibilities prior to commencement of work:

1. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment, and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area**.
2. Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized, calibration data and method of analysis. During abatement, submit to the Contractor, results of bulk material analysis and

air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

L. Site Security:

1. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and Representatives, State and Local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and shall be posted in the clean room of the decontamination unit.
2. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent person shall immediately notify the VA Representative.
3. A log book shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
4. Access to the regulated area shall be through a critical barrier doorway. All other access (doors, windows, hallways, etc.) shall be sealed or locked to prevent entry to or exit from the regulated area. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall <u>not</u> be locked from the inside; however, they shall be sealed with poly sheeting and taped until needed.
5. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24-hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.
6. The regulated area shall be locked during non-working hours and secured by VA security guards.

M. Emergency Action Plan and Arrangements:

1. An Emergency Action Plan shall be developed prior to commencing abatement activities and shall be agreed to by the Contractor and the VA. The Plan shall meet the requirements of 29 CFR 1926, Subpart C, Standard 1926.35 Employee Emergency Action Plans.
2. Emergency procedures shall be in written form and prominently posted in the clean room and equipment room of the decontamination unit. Everyone, prior to entering the regulated

area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.

3. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule; layout of regulated area; and access to the regulated area, particularly barriers that may affect response capabilities.
4. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.
5. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.
   a. For non-life-threatening situations - employees injured or otherwise incapacitated shall be decontaminated following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.
   b. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, medical personnel shall remove them from the regulated area if back or neck injury is present, and secure proper medical treatment.
6. Telephone numbers of any/all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
7. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3-4 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
8. The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the Asbestos Hazard Abatement Plans during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

N. Pre-Construction Meeting:

1. Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (VPIH/CIH) to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:
   a. Proof of Contractor licensing.
   b. Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.
   c. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
   d. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
   e. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
   f. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
   g. A copy of the Contractor's Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project.
      1)Regulated area preparation procedures;
      2)Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d) Multi-Employer Worksites;
      3)Decontamination area set-up/layout and decontamination procedures for employees;
      4)Abatement methods/procedures and equipment to be used;
      5)Personal protective equipment to be used.
   h. At this meeting the Contractor shall provide all submittals as required.
   i. Procedures for handling, packaging and disposal of asbestos waste.
   j. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

A. The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1. Personnel:
   a. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.
   b. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; last four digits of social security number; qualifications; accreditation card with color picture, if required by state; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
   c. Minimum qualifications for Contractor and assigned personnel are:
      1)The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of Federal (and State or Local as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable state; has adequate and qualified personnel available to complete the work; has comprehensive Abatement Hazard Abatement Plans for asbestos work; has adequate materials, equipment and supplies to perform the work.
      2)The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project within the past three (3) years; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.

3)The Contractor Professional Industrial Hygienist/CIH (CPIH/CIH) shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has specialized EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course or equivalent, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.

4)The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the Asbestos Hazard Abatement Plans of the Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; and has certificate of training/current refresher and State accreditation/license.

d. All personnel shall be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

A. General - Respiratory Protection Program: The Contractor shall develop and implement a written Respiratory Protection Program (RPP) which is in compliance with OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.134. ANSI Standard Z88.2-2015 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written RPP shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c) - Respiratory Protection Program.

B. Respiratory Protection Program Coordinator: The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years of experience coordinating RPP of similar size and complexity. The RPPC must submit a signed statement attesting to the fact that the program meets the above requirements.

C. Selection and Use of Respirators: The procedure for the selection and use of respirators must be submitted to the VA as part of the Contractor's qualifications. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit or in the onsite Contractor’s office, for reference by employees or authorized visitors.

D. Minimum Respiratory Protection: Shall be a ½-mask negative pressure air purifying respirator equipped with Combination P100 filters and Organic Vapor Cartridge, provided personal air samples in the workplace remain at or below 0.1 f/cc, and the applicable PEL for solvents, both determined as an 8-hour TWA. Full face powered air purifying respirator equipped with P100 filters and Organic Vapor Cartridge shall be required until Contractor demonstrates that personal air samples are at or below 0.1 f/cc, and the applicable PEL for solvents, both determined as an 8-hour TWA. A higher level of respiratory protection shall be required, if fiber levels exceed 1 f/cc as an 8-hour TWA, inside the regulated work area. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h) and 29 CFR 1910.134 (d)(3)(i)(A) Table 1, except as indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

E. Medical Written Opinion: No employee shall be allowed to wear a respirator unless a physician or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

F. Respirator Fit Test: All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

G. Respirator Fit Check: The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from entering the regulated area until resolution of the problem.

H. Maintenance and Care of Respirators: The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) Maintenance and Care of Respirators.

I. Supplied Air Systems: If a supplied air system is used, the system shall meet all requirements of 29 CFR 1910.134 and the ANSI/Compressed Gas Association (CGA) Commodity Specification for Air current requirements for Type 1 - Grade D breathing air. Low pressure systems are not allowed to be used on asbestos abatement projects. Supplied Air respirator use shall be in accordance with EPA/NIOSH publication EPA-560-OPTS-86-001 "A Guide to Respiratory

Protection for the Asbestos Abatement Industry". The competent person on site will be responsible for the supplied air system to ensure the safety of the worker.

1.8 WORKER PROTECTION

A. Training of Abatement Personnel: Prior to to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

B. Medical Examinations: Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion that the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

C. Personal Protective Equipment: Provide whole body clothing, head coverings, foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

D. Regulated Area Entry Procedure: The Competent Person shall ensure that each time workers enter the regulated area they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

E. Decontamination Procedure: The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

1. When exiting the regulated area, remove all disposable PPE and dispose of in a disposable bag provided in the regulated area.
2. Carefully decontaminate and clean the respirator. Put in a clean container/bag.

F. Regulated Area Requirements: The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for Class II regulated areas at 29 CFR 1926.1101 (e) are met applicable to Class II work and this specification. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

A. Description: Provide each each regulated area with separate personnel decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

B. General Requirements: All personnel entering or exiting a regulated area must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3-layers of 6-mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3-layers of 6-mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weight inner doorway sheets with layers of duct tape so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting and reduce potential for non-authorized personnel entering the regulated area.

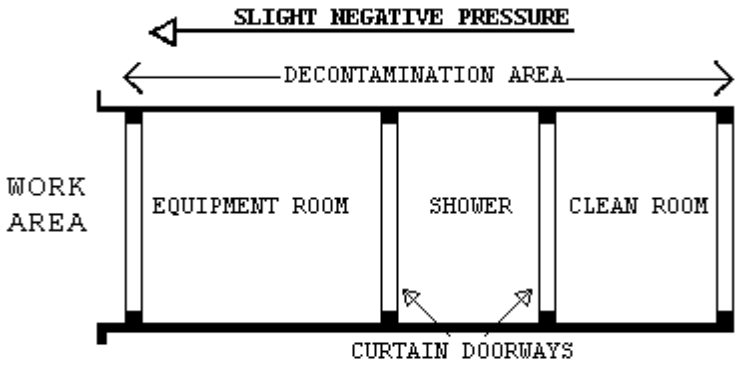
C. Temporary Facilities to the PDF and W/EDF: The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141 (d)(3). Provide adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat, if needed, to maintain 70°F throughout the PDF and W/EDF.

D. Personnel Decontamination Facility (PDF):

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 3-layers of 6-mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6-mil poly opaque fire retardant doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry and sanitary condition. Shower overflow shall not be allowed into the clean room. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Male/Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male/female can enter or exit the PDF during his/her stay in the PDF.
2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the equipment room to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using air tight walls made from at least 3-layers of 6-mil opaque fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Waste water will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose

down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.

3. Equipment Room: The Competent Person shall provide an equipment room which shall be an air tight compartment for the storage of work equipment/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2-layers of 6-mil opaque fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by air tight walls and ceiling constructed of a minimum of 3-layers of 6-mil opaque fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6-mil fire retardant poly per shift change and remove this layer after each shift. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
4. The PDF shall be as follows: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF shall be a minimum of 2 layers of 6-mil opaque fire retardant poly.



E. Waste/Equipment Decontamination Facility (W/EDF):

1. The Competent Person shall provide an W/EDF consisting of a wash room, holding room, and clean room for removal of waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be

wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:

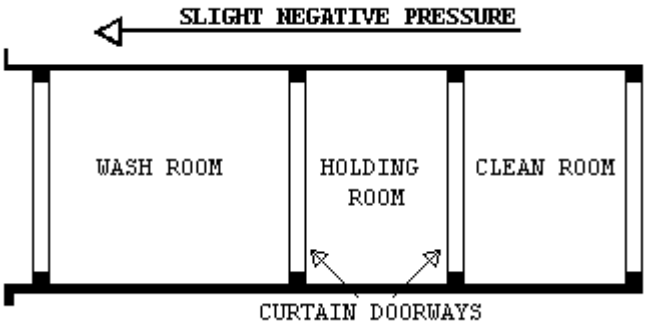
a. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Wash Room as an equipment bag and container cleaning station.

b. Wash Room: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the wash room using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3-layers of 6-mil fire retardant poly. Locate the wash room so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the wash room shall be constructed of 2-layers of 6-mil fire retardant poly.

c. Holding Room: Provide a holding room as a drop location for bagged materials passed from the wash room. Construct the holding room using 50 x 100 mm (2 inches x 4 inches) wood framing or approved equivalent and 3-layers of 6-mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the wash room to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6-mil fire retardant poly.

d. Clean Room: Provide a clean room to isolate the holding room from the exterior of the regulated area. Construct the clean room using 2 inches x 4 inches wood framing or approved equivalent and 2-layers of 6-mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of 2-layers of 6-mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.

e. The W/EDF shall be as follows: Wash Room leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



F. Waste/Equipment Decontamination Procedures: At the washdown station, in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Wash Room after visual inspection. When passing anything into the Wash Room, close all doorways of the W/EDF, other than the doorway between the washdown station and the Wash Room. Keep all outside personnel clear of the W/EDF. Once inside the Wash Room, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. At no time shall personnel from the clean side be allowed to enter the Wash Room.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General Requirements (All Abatement Project): Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the CPIH/CIH has submitted verification to the VA's Representative.

1. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
2. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated area until abatement is completed.
3. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized location.
4. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.

5. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
6. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the VA and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of moisture resistant duct tape, poly tape, furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other approved equivalent procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
7. Polyethylene sheeting utilized for the PDF shall be opaque white or black in color, 6-mil fire retardant poly.
8. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and waste water filtration system shall be provided by the Contractor.
9. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements, fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.
10. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water and falling material).
11. Disposal bags – 2 layers of 6-mil poly for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
12. The VA shall be provided an advance copy of the Safety Data Sheets (SDS) as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-project submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.
13. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.

14. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

B. Negative Pressure Filtration System:

1. The Contractor shall provide enough HEPA negative air machines to continuously maintain a negative pressure differential of -0.02 inches water column gauge (WCG) inside the regulated work area relative to adjacent non-work building areas. OSHA 29 CFR 1926.1101 (g)(5)(i)(A)(2) also requires at least four (4) air changes per hour. Contractor shall increase air changes per hour as necessary to maintain volatile organic compounds below the applicable OSHA PEL. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to continuously maintain a negative pressure differential of -0.02 inches WCG. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area. HEPA equipped negative air machines shall be discharged outside of the building a minimum of 3 feet from building make-up air, doors, open windows, patients, visitors and staff.
2. NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50 percent efficiency. The contractor shall consider this in their determination of number of units needed to continuously maintain a pressure differential of -0.02 inches WCG. The contractor shall use 8 air changes per hour or double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2 inches pressure drop across the filters.

C. Design and Layout:

1. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:
   a. Method of supplying power to the units and designation/location of the panels.
   b. Description of testing method(s) for correct air volume and pressure differential.

c. If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.

D. Negative Air Machines (HEPA Units)

1. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30 inches in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
2. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.
3. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97 percent. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.
4. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 micron or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 micron or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.
5. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for various pressure readings on

the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.

6. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.
7. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.
8. It is essential that replacement HEPA filters be tested using an “in-line” testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters.
9. Pressure Differential: The fully operational negative air system within the regulated area shall continuously maintain a pressure differential $\geq$ -0.02 inches WCG inside the regulated work area. Before any disturbance of any asbestos material, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(g)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.

2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

A. General:

1. Using critical barriers, seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, Contractor shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire

barrier penetrations due to abatement work as specified in Specification Section 07 84 00; FIRESTOPPING and Section 2.2.6.

2. Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2-layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area

B. Controlling Access to the Regulated Area: Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA DANGER demarcation signs posted as required by OSHA. If the regulated area is adjacent to, or within view of an occupied area, provide a visual barrier of 6-mil opaque fire retardant poly to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

C. Critical Barriers: Completely separate any operations in the regulated area from adjacent areas using 2-layers of 6-mil fire retardant poly and duct tape. Individually seal with 2-layers of 6-mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects/openings in the regulated area. Heat must be shut off any objects covered with poly.

D. Secondary Barriers: A loose layer of 6-mil poly shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work and at a minimum once per work day.

E. Extension of the Regulated Area: If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

F. Firestopping:

1. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. must be firestopped with a fire-rated firestop system providing an air tight seal.

2. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the VA Representative. The contractor shall list all areas of penetration, the type of sealant used, and whether or not the location is fire rated. Any discovery of

penetrations during abatement shall be brought to the attention of the VA Representative immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the VA Representative or Fire Marshall.

3. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the VA Representative for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed

2.3 MONITORING, INSPECTION AND TESTING

A. General:

1. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. OSHA requires that the Employee exposure to asbestos must not exceed 0.1 fibers per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications. In addition, the CPIH/CIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples inside the building, but outside the regulated area. Inside the building, but outside the regulated area air samples shall be collected in the Clean Room of the PDF, at the approximate location of HEPA exhaust discharge, and at a minimum of three (3) locations in areas immediately outside the regulated work area to satisfy this specification. Additional inspection and testing requirements are also indicated in other parts of this specification.
2. The VA will employ an independent industrial hygienist (VPIH/CIH) consultant and/or use its own IH to perform various services on behalf of the VA. The VPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that VA patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the VPIH/CIH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services

as specified. The cost of the VPIH/CIH and their services will be borne by the VA except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.

3. If fibers counted by the VPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the VA's Representative. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. Confirmation sampling and analysis will be the responsibility of the CPIH/CIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH and the VPIH/CIH shall be reached on the exact details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed by the IH's and delivered to the VA's Representative

B. Scope of Services of the VPIS/CIH Consultant:

1. The purpose of the work of the VPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM. The VPIH/CIH will perform the following tasks:
   a. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
   b. Task 2: Perform Representative air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
   c. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing

inside and outside the regulated area and all aspects of the operation except personnel monitoring.

d. Task 4: Provide support to the VA Representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.

e. Task 5: Perform, in the presence of the VA Representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.

f. Task 6: Issue certificate of decontamination for each regulated area and project report.

2. All documentation, inspection results and testing results generated by the VPIH/CIH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the VPIH/CIH for efficient and smooth performance of their work.

3. The monitoring and inspection results of the VPIH/CIH will be used by the VA to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

C. Monitoring, Inspection and Testing by Contractor CPIH/CIH: The Contractor's CPIH/CIH is responsible for managing all monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH/CIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of the Contractor's personnel. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the Contractor/Competent Person. The person performing the personnel and area air monitoring inside the regulated area shall be an IH Technician, who shall be trained and shall have specialized field experience in sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytical Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA AHERA/State Contractor/Supervisor and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples and have experience in substantially similar projects in size and scope. The analytical laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved

by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for personal and area air monitoring for asbestos in 29 CFR 1926.1101 (f), (g) and Appendix A. This log shall be made available to the VA Representative and the VPIH/CIH upon request. The log will contain, at a minimum, information on personnel or area samples, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH/CIH shall collect and analyze samples for each Representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two (2) personal air samples or 25 percent of Representative workforce per shift shall be collected, whichever is greater, in the regulated area; a minimum of three (3) area air samples at locations inside the building but immediately outside the regulated work area; one (1) area air sample shall be collected daily in the Clean Room of the PDF; and one (1) area air sample shall be collected daily at the approximate location of HEPA exhaust discharge. In addition to the continuous monitoring required, the CPIH/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.4 ASBESTOS HAZARD ABATEMENT PLAN

A. The Contractor shall have an established Asbestos Hazard Abatement Plan (AHAP) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the procedures to be followed during all phases of the work by the Contractor's personnel. The AHAP must be modified as needed to address specific requirements of this project and the specifications. The AHAP(s) shall be submitted for review and approval to the VA prior to the start of any abatement work. The minimum topics and areas to be covered by the AHAP(s) are:

1. Minimum Personnel Qualifications
2. Emergency Action Plan/Contingency Plans and Arrangements
3. Security and Safety Procedures
4. Respiratory Protection/Personal Protective Equipment Program and Training
5. Medical Surveillance Program and Recordkeeping
6. Regulated Area Requirements - Containment Barriers/Isolation of Regulated Area

7. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
8. Negative Pressure Systems Requirements
9. Monitoring, Inspections, and Testing
10. Removal Procedures for ACM
11. Removal of Contaminated Soil (if applicable)
12. Encapsulation Procedures for ACM
13. Disposal of ACM waste/equipment
14. Regulated Area Decontamination/Clean-up
15. Regulated Area Visual and Air Clearance
16. Project Completion/Closeout

2.5 SUBMITTALS

A. Pre-Start Meeting Submittals:

1. Submit to the VA a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project:
   a. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
   b. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
   c. Submit Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
   d. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
      1)Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
      2)Waste water filtration system, shower system, containment barriers.

3)Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.

4)Respirators, protective clothing, fall protection and other required personal protective equipment.

5)Fire safety equipment to be used in the regulated area.

e. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.

f. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.

g. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.

h. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.

1)Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project: Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date

2)List of project(s) halted by owner, A/E, IH, regulatory agency in the last 3 years: Project Name; Reason; Date; Reference Name/Number; Resolution

3)List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including the company’s officers (including damages paid) in the last 3 years. Provide copies and all information needed for verification.

i. Submit information on personnel: Provide a resume; address each item completely; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and that the company has implemented a medical surveillance program and written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

1)CPIH/CIH and IH Technician: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; medical opinion; and current respirator fit test.

2)Competent Person(s)/Supervisor(s): Number; names; last four digits of social security numbers; years of abatement experience as Competent Person/Supervisor; list of similar projects in size/complexity as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

3)Workers: Numbers; names; last four digits of social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

j. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of the AHAP incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and Asbestos Hazard Abatement Plans; copies of monitoring results of the five referenced projects listed and analytical methods used.

k. Rented equipment must be decontaminated prior to returning to the rental agency.

l. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all SDS, and application instructions.

B. Submittals During Abatement:

1. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as barrier breeching, equipment failures, emergencies, and any cause for stopping work; Representative air monitoring and results/TWAs/ELs. Submit this information daily to the VA's Representative.
2. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
   a. Removal of any poly barriers.
   b. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
   c. Packaging and removal of ACM waste from regulated area.
   d. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's Representative on a weekly basis.

C. Submittals at Completion of Abatement: The CPIH/CIH shall submit a project report consisting of the daily log book requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA Representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

PART 3 - EXECUTION

3.1 PRE-ABATEMENT ACTIVITIES

A. Pre-Abatement Meeting: The VA Representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH/CIH, Competent Person, the VA Representative(s), and the

VPIH/CIH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the VA's Representative regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the VA's Representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the VA written order to proceed.

B. Pre-Abatement Inspections and Preparations:

1. Before any work begins on the construction of the regulated area, the Contractor will:
   a. Conduct a space-by-space inspection with an authorized VA Representative and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.
   b. The VA Representative, the Contractor, and the VPIH/CIH must be aware of AEQA 10-95 indicating the failure to identify asbestos in the areas listed as well as common issues when preparing specifications and contract documents. This is especially critical when demolition is planned, because AHERA surveys are non-destructive, and ACM may remain undetected. A NESHAP (destructive) ACM inspection should be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: Lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawl spaces(previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line trench coverings.
   c. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed from the regulated area have been cleaned and removed or properly protected from contamination.
   d. If present and required, remove and dispose of carpeting from floors in the regulated area. If carpet comes up without disturbing ACM flooring material, the carpet can be disposed of as C&D waste. If ACM floor tile is attached to the carpet while the

Contractor is removing the carpet, that section of the carpet will be disposed of as asbestos waste.

e. Inspect existing firestopping in the regulated area. Correct as needed.

C. Pre-Abatement Construction and Operations:

1. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.
2. Upon completion of all preparatory work, the CPIH/CIH will inspect the work and systems and will notify the VA's Representative when the work is completed in accordance with this specification. The VA's Representative may inspect the regulated area and the systems with the VPIH/CIH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved AHAP, especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.
3. The CPIH/CIH shall document the pre-abatement activities described above and deliver a copy to the VA's Representative.
4. Upon satisfactory inspection of the installation of and operation of systems the VA's Representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification and all applicable regulations

3.2 REGULATED AREA PREPARATIONS

A. OSHA DANGER Signs: Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.

B. Controlling Access to the Regulated Area: Access to the regulated area is allowed only through the personnel decontamination facility (PDF), if required. All other means of access shall be eliminated and OSHA Danger demarcation signs posted as required by OSHA. If the regulated area is adjacent to or within view of an occupied area, provide a visual barrier of 6-mil opaque fire retardant poly sheeting to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid.

C. Shut Down – Lock Out Electrical: Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.

D. Shut Down – Lock Out HVAC: Shut down and lock out/tag out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the VA's Representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of independently installed 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil polyethylene disposal bags for staging and eventual disposal as asbestos waste.

E. Sanitary Facilities: The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

F. Water for Abatement: The VA will provide water for abatement purposes. The Contractor shall connect to the existing VA system. The service to the shower(s) shall be supplied with backflow prevention.

G. Preparation Prior to Sealing Off: Place all tools, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. Remove all uncontaminated removable furniture, equipment and/or supplies from the regulated area before commencing work, or completely cover with 2-layers of 6-mil fire retardant poly sheeting and secure with duct tape.

H. Critical Barriers: Completely separate any openings into the regulated area from adjacent areas using fire retardant poly at least 6-mils thick and duct tape. Individually seal with 2-layers of independently installed 6-mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects in the regulated area. Heat must be shut off any objects covered with poly.

I. Floor Barriers: If floor removal is not being done, all floors in the regulated area shall be covered with 2-layers of 6-mil fire retardant poly and brought up the wall 24 inches.

   1.

   2.

J. Extension of the Regulated Area: If the regulated area barrier is breached in any manner that could allow the passage of asbestos fibers or debris, the Competent Person shall immediately stop work, continue wetting, and proceed to extend the regulated area to enclose the affected

area as per procedures described in this specification. If the affected area cannot be enclosed, decontamination measures and cleanup shall start immediately. All personnel shall be isolated from the affected area until decontamination/cleanup is completed as verified by visual inspection and air monitoring. Air monitoring at completion must indicate background levels.

3.3 REMOVABLE OF CLASS II FLOORING AND MASTIC, MATERIALS

A. General: All applicable requirements of OSHA, EPA, and DOT shall be followed during Class II work. Keep materials intact to the extent feasible; wet while working with it; wrap as soon as possible with 2-layers of 6-mil plastic for disposal.

B. Removal of Flooring Materials:

1. All requirements of OSHA Flooring agreement provisions shall be followed:
   a. The Contractor shall provide enough HEPA negative air machines to effect > -0.02 inches WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2 inches pressure drop across the filters.
   b. Flooring shall be removed intact, as much as feasible. Do not rip or tear flooring.
   c. Mechanical chipping or sanding is not allowed.
   d. Flooring may be removed with an infra-red heating unit operated by trained personnel following the manufacturer's instructions.
   e. Wet clean and HEPA vacuum the floor before and after removal of flooring.
   f. Place a 6-mil poly layer 4 feet by 10 feet adjacent to the regulated area for use as a decontamination area if a PDF is not specified. All waste must be contained in the regulated area.
   g. Package all waste in 6-mil poly lined fiberboard drums or double bag in 6-mil polyethylene bags.

C. REMOVAL OF MASTIC

1. All chemical mastic removers must be low in volatile organic compound (VOC) content, have a flash point greater than 200 degrees Fahrenheit, contain no chlorinated solvents, and comply with California Air Resources Board (CARB) thresholds for VOCs (effective January 1, 2010).
2. Negative air machine as required under flooring removal shall be provided and operated in accordance with this project specification.

3. Follow all manufacturers' instructions in the use of the mastic removal material. Verify that there are no ignition sources in the work area and minimize the amount of mastic removal material used at any given time to eliminate fire hazards and objectionable odors.
4. Package all waste in 6-mil poly lined fiberboard drums or double bag in 6-mil polyethylene bags.

3.4 DISPOSAL OF CLASS II WASTE MATERIAL

A. General: Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR 171–180 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable State and Local regulations.

3.5 PROJECT DECONTAMINATION

A. General:
   1. The VA must be notified at least 24 hours in advance of any waste removed from the containment.
   2. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
   3. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleanings of the surfaces of the regulated area after the primary barrier removal.
   4. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.
B. Regulated Area Clearance: Air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures
C. Work Description: Decontamination includes the clearance air testing in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities, and negative pressure systems.

D. Pre-Decontamination Conditions:

1. Before decontamination starts, all ACM waste from the regulated area shall be removed, all waste collected and removed, and the secondary barrier of poly removed and disposed of along with any gross debris generated by the work.
2. At the start of decontamination, the following shall be in place:
   a. Critical barriers over all openings consisting of two layers of 6-mil poly which is the sole barrier between the regulated area and the rest of the building or outside.
   b. Decontamination facilities, if required for personnel and equipment in operating condition.

E. Cleaning: Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and HEPA vacuuming. Do not use dry dusting/sweeping/air blowing methods. Use each surface of a wetted cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

3.6 VISUAL INSPECTION AND AIR CLEARANCE TESTING

A. General: Notify the VA Representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the VPIH/CIH after the final cleaning.

B. Visual Inspection: Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no additional cost to the VA. Dust/material samples may be collected and analyzed at no additional cost to the VA at the discretion of the VPIH/CIH to confirm visual findings. When the regulated area is visually clean the final testing can be done

C. Air Clearance Testing:

1. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of two field blank. If

work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA presented in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor.**

2. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

D. Final Air Clearance Procedures:

1. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured by the AHERA PCM protocol and $\leq$ 70 AHERA asbestos structures per square millimeter (s/mm^2) by AHERA TEM. No averaging of results will be used for this project. All five (5) TEM samples inside the regulated area shall be at or below 70 asbestos s/mm^2 to satisfy the project final clearance criteria.
2. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the VPIH/CIH will secure samples and analyze them according to the following procedures.
   a. Fibers Counted: “Fibers” referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the AHERA TEM method.
   b. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques. Samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ MCE for TEM. A minimum of 3850 Liters of air using calibrated sampling pumps shall be collected for PCM samples and a minimum of 1200 Liters of air using calibrated sampling pumps shall be collected for TEM clearance samples. Before pumps are started, initiate aggressive air mixing sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off. The negative pressure system shall continue to operate.

3.7 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

A. Completion of Abatement Work:

1. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
    a. Remove all equipment, materials, and debris from the project area.
    b. Package and dispose of all asbestos waste as required.
    c. Repair or replace all interior finishes damaged during the abatement work.
    d. Fulfill other project closeout requirements as specified elsewhere in this specification

B. Certificate of Completion by Contractor: The CPIH shall complete and sign the "Certificate of Completion" in accordance with Attachment 1 at the completion of the abatement and decontamination of the regulated area.

C. Work Shifts: All work shall generally be done during administrative hours (8:00 AM to 4:30 PM) Monday - Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the VA Representative.

ATTACHMENT #1
CERTIFICATE OF COMPLETION

DATE: _____ VA Project #:_____

PROJECT NAME:_____ Abatement Contractor:_____

VAMC/ADDRESS:_____

1. I certify that I have personally inspected, monitored and supervised the abatement work of (specify regulated area or Building):
   which took place from / / to / /
2. That throughout the work all applicable requirements/regulations and the VA's specifications were met.
3. That any person who entered the regulated area was protected with the appropriate personal protective equipment and respirator and that they followed the proper entry and exit procedures and the proper operating procedures for the duration of the work.
4. That all employees of the Abatement Contractor engaged in this work were trained in respiratory protection, were experienced with abatement work, had proper medical surveillance documentation, were fit-tested for their respirator, and were not exposed at any time during the work to asbestos without the benefit of appropriate respiratory protection.
5. That I performed and supervised all inspection and testing specified and required by applicable regulations and VA specifications.
6. That the conditions inside the regulated area were always maintained in a safe and healthy condition and the maximum fiber count never exceeded 0.5 f/cc, except as described below.
7. That all abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date:_____

CPIH/CIH Print Name:_____

Abatement Contractor Signature/Date:_____

Abatement Contractor Print Name:_____

ATTACHMENT #2
CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME:_____DATE:_____

PROJECT ADDRESS:_____

ABATEMENT CONTRACTOR'S NAME:_____

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate of worker's acknowledgement you are indicating to the owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32-hours minimum duration. I currently have a valid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

Physical Characteristics and Background Information on Asbestos
Potential Health Effects Related to Exposure to Asbestos
Employee Personal Protective Equipment
Establishment of a Respiratory Protection Program
State of the Art Work Practices
Personal Hygiene
Additional Safety Hazards
Medical Monitoring
Air Monitoring
Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature:_____

Printed Name:_____

Social Security Number:_____

Witness:_____

ATTACHMENT #3
AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND TRAINING/ACCREDITATION

VA PROJECT NAME AND NUMBER:_____

VA MEDICAL FACILITY:_____

ABATEMENT CONTRACTOR'S NAME AND ADDRESS:_____

1. I verify that the following individual

Name:_____ Social Security Number:

_____who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

Address:_____

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.

3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.

4. I verify that I meet the minimum qualifications criteria of the VA specifications for a CPIH.

Signature of CPIH/CIH:_____ Date:_____

Printed Name of CPIH/CIH:_____

Signature of Contractor:_____ Date:_____

Printed Name of Contractor:_____

ATTACHMENT #4
ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE VA'S ASBESTOS SPECIFICATIONS

VA Project Location:_____

VA Project #:_____

VA Project Description:_____

1. This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the VA related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

2 I, the undersigned, have read VA's Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the VA's Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the VA's Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the VA's Asbestos Specification.

3. At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the VA's Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner's Signature_____Date_____

- - - E N D - - -

SECTION 02 83 33.13
LEAD-BASED PAINT REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing and disposal of lead-based paint (LBP) at interior locations indicated in existing conditions report.

1.2 RELATED WORK

A. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Hazardous Material Abatement.

B. Section 09 91 00, PAINTING: Surface Preparation Disturbing Lead-Based Paint.

1.3 DEFINITIONS

A. Action Level: Employee exposure, without regard to use of respirator, to an airborne lead concentration of 30 micrograms(µ) per cubic meter (m^3) of air determined as an 8-hour Time-Weighted Average (TWA). As used in this section, ”30 micrograms per cubic meter of air" refers to OSHA 29 CFR 1926.62 Lead in Construction Action Level (AL).

B. Area Monitoring: Sampling of lead concentrations within lead control area and inside physical boundaries which are representative of airborne lead concentrations which may reach breathing zone of personnel potentially exposed to lead.

C. Breathing Zone: Area within hemisphere, forward of shoulders, with 150 mm to 225 mm (6 to 9 inches) radius and center at nose or mouth of employee.

D. Certified Industrial Hygienist (CIH): As used in this section, refers to an Industrial Hygienist Certified in the Comprehensive Practice of Industrial Hygiene by the American Board of Industrial Hygiene and Board for Global EHS Credentialing, employed by Contractor.

E. Change Rooms and Shower Facilities: Rooms within designated physical boundary around lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevents cross contamination.

F. Competent Person: Person capable of identifying lead hazards in work area and authorized by contractor to take corrective action. Meets the OSHA definition of Competent Person.

G. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).

H. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over 8-hour workday to which an employee is exposed.

I. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. HEPA filter means 99.97 percent efficient against 0.3 micron (0.012 mil) size particles.

J. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

K. Lead Control Area: Enclosed area or structure with full containment to prevent spreading lead dust, paint chips, and debris from lead-based paint removal operations. Lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

L. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air (50 $\mu g/m^3$) determined as an 8-hour TWA as determined by 29 CFR Part 1926.62. When employee is exposed for more than 8-hours per work day, determine PEL by the following formula. PEL micrograms/cubic meter (parts per million) of air = 400/No. of hrs. worked per day.

M. Personnel Monitoring: Sampling of lead concentrations within employee breathing zone to determine 8-hour time weighted average concentration according to 29 CFR Part 1926.62. Take samples that are representative of the various employee's work tasks.

N. Physical Boundary: Area physically roped or partitioned off around enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean same as "outside lead control area."

1.4 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute (ANSI):

Z9.2-2018 ..... Fundamentals Governing the Design & Operation of Local Exhaust Ventilation Systems.

C. Code of Federal Regulations (CFR):

29 CFR Part 1910..... Occupational Safety and Health Standards.

29 CFR Part 1926..... Safety and Health Regulations for Construction.

40 CFR Part 260..... Hazardous Waste Management System: General.

40 CFR Part 261..... Identification and Listing of Hazardous Waste.

40 CFR Part 262..... Standards Applicable to Generators of Hazardous Waste.

40 CFR Part 263..... Standards Applicable to Transporters of Hazardous Waste.

40 CFR Part 264..... Standards for Owners and Operations of Hazardous Waste Treatment, Storage, and Disposal Facilities.

40 CFR Part 265.....Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

40 CFR Part 268.....Land Disposal Restrictions.

49 CFR Part 172.....Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements, and Security Plans.

49 CFR Part 178.....Specifications for Packaging.

D. Underwriters Laboratories (UL):

586-09 .....High-Efficiency, Particulate, Air Filter Units.

1.5 PRE-REMOVAL MEETINGS

A. Conduct pre-removal meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. Certified Industrial Hygienist.
   c. Architect/Engineer.
   d. Inspection and Testing Agency.
   e. Contractor.
   f. Paint removal contractor.
   g. Other installers responsible for finishing resulting surfaces.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Respiratory protection program.
   b. Hazard communication program.
   c. Hazardous waste management plan.
   d. Safety and health regulation compliance.
   e. Employee training.
   f. Removal schedule.
   g. Removal sequence.
   h. Preparatory work.
   i. Protection before, during, and after removal.
   j. Removal.
   k. Inspecting and testing.

l. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.6 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Description of each product.

a. Paint removal products.

b. Vacuum filters.

c. Respirators.

2. Safety Data Sheet for each paint removal product.

3. Installation instructions.

a. Paint removal products.

C. Test Reports: Submit testing laboratory reports.

1. Submit air monitoring results within three working days, signed by testing laboratory employee performing air monitoring, employee analyzing sample, and CIH.

D. Certificates: Certify completed lead training.

1. Submit certificate for each employee signed and dated by CIH and employee stating employee was trained.

E. Qualifications: Substantiate qualifications comply with specifications.

1. Paint removal contractor.

2. Testing laboratory.

a. Name, address, and telephone number.

b. Current evidence of participation in American Industrial Hygiene Association (AIHA) Laboratory Accreditation Program (LAP), LLC, Environmental Lead Laboratory Accreditation Program (ELLAP).

c. Copy of current AIHA accreditation certificate.

3. Industrial hygienist.

a. Name, address, and telephone number.

b. Resume showing previous experience.

c. Copy of current ABIH CIH certification.

4. Paint disposal facility.

a. Name, address, and telephone number.

b. Current license or authorization to receive and dispose lead contaminated waste.

F. Record Documents:

1. Completed and signed hazardous waste manifest from waste transporter.
2. Toxicity Characteristic Leaching Procedure (TCLP) test results to determine if waste is hazardous.
3. Paint disposal facility receipts and disposition reports.
4. Certification of medical examinations.
5. Medical Opinion that employee is qualified to wear a respirator, that employees has been trained and fit tested for the respirator.
6. Employee training certification.

1.7 QUALITY ASSURANCE

A. Safety and Health Regulation Compliance:

1. Comply with laws, ordinances, rules, and regulations of Federal, State, and Local authorities having jurisdiction regarding removing, handling, storing, transporting, and disposing lead waste materials.

a. Comply with applicable requirements of 29 CFR Part 1926.62.

b. Notify Contracting Officer's Representative and request resolution of conflicts between regulations and specified requirements before starting work.

2. Comply with the following local laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing lead-contaminated materials:

a. Vermont Department of Health, Chapter 6 – Environmental Health Rules Subchapter 3, Vermont Regulations for Lead Control

B. Paint Removal Contractor: Experienced contractor, registered or licensed by applicable state agency regulating lead-based paint removal.

C. Testing Laboratory: State certified independent testing laboratory experienced in airborne lead monitoring, testing, and reporting.

1. Successful participant in American Industrial Hygiene Association (AIHA) Laboratory Accreditation Program (LAP), LLC, Environmental Lead Laboratory Accreditation Program (ELLAP).

D. Certified Industrial Hygienist: Certified as CIH by American Board of Industrial Hygiene in comprehensive practice and responsible for:

1. Certify Training.
2. Review and approve lead-based paint removal plan for conformance to applicable referenced standards.
3. Inspect lead-based paint removal work for conformance with approved plan.
4. Direct monitoring.
5. Ensure work is performed according to specifications.
6. Ensure personnel and environment hazardous exposures are adequately controlled.

E. Paint Disposal Facility: State certified disposal facility qualified to receive and dispose lead-based paint.

F. Lead-based Paint Removal Plan:
1. Submit detailed, site-specific plan describing lead-based paint removal procedures.
2. Include sketch showing location, size, and details of lead control areas, decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.
3. Include eating, drinking, and restroom procedures, interface of trades, work sequencing, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and detailed description of containment methods ensuring airborne lead concentrations do not exceed action level outside lead control area.
   a. Eating, drinking, and smoking are not acceptable within lead control area.
4. Include air sampling, training and strategy, sampling methodology, frequency, duration, and qualifications of air monitoring personnel.

G. Respiratory Protection Program: Establish and implement program required by 29 CFR Part 1910.134 and 29 CFR Part 1926.62.
1. Provide each employee negative pressure or other appropriate respirator.
   a. Respirator fit each employee's respirator at initial fitting and at least annually thereafter, as required by 29 CFR Part 1910.134 Respiratory Protection.

H. Hazard Communication Program: Establish and implement program required by 29 CFR Part 1910.1200 which is the same as 29 CFR 1926.59.

I. Hazardous Waste Management Plan: Establish and implement plan according to applicable requirements of Federal, State, and Local hazardous waste regulations including the following:
1. Identification of hazardous wastes associated with work.
2. Estimated quantities of generated and disposed waste.

3. Names and qualifications of each contractor transporting, storing, treating, and disposing wastes. Include facility location and 24-hour point of contact. Provide two copies of EPA, State, and Local hazardous waste permits and EPA Identification numbers.
4. Names and qualifications (experience and training) of personnel working on-site with hazardous wastes.
5. List of required waste handling equipment including cleaning, volume reduction, and transport equipment.
6. Spill prevention, containment, and cleanup contingency implementation measures.
7. Work plan and schedule for waste containment, removal, and disposal with daily waste cleaned up and containerization.
8. Hazardous waste disposal cost.

1.8 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PAINT REMOVAL PRODUCTS

A. Chemical Stripper: Biodegradable, non-toxic, capable of removing existing paint layers in one application, and acceptable to CIH.

2.2 ACCESSORIES

A. Waste Collection Drums: 49 CFR Part 178; Type 1A2, steel, removable head, 200 L (55 gal.) capacity, capable of containing waste without loss.
B. Vacuum Cleaner: HEPA filtered type.
C. Scrapers:
   1. Metal type for use on metal, concrete, and masonry surfaces.
   2. Plastic type for use on wood, plaster, gypsum board, and other surfaces.
D. Rinse Water: Potable.
E. Cleaning Cloths: Cotton.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before exposure to lead-contaminated dust, provide workers with comprehensive medical examination required by 29 CFR Part 1926.62 (j) Medical Surveillance.
B. Maintain complete and accurate employee medical records according to 29 CFR Part 1910.1020.

C. Train each employee performing paint removal, disposal, and air sampling operations according to 29 CFR Part 1926.62.
   1. Certify training is completed before employee is permitted to work on project and enter lead control area.

3.2 PREPARATION

A. Protect existing work indicated to remain.
   1. Perform paint removal work without damaging and contaminating adjacent work.
   2. Restore damage and contamination to original condition.
B. Notify Contracting Officer 20 days before starting paint removal work.
C. Lead Control Area Requirements:
   1. Establish lead control area by completely enclosing lead-based paint removal work area with containment screens.
   2. Contain removal operations using negative pressure full containment system with minimum one change room and HEPA filtered exhaust.
D. Boundary Requirements: Provide physical boundaries around lead control area by roping off area designated on drawings or providing curtains, portable partitions or other enclosures to ensure that airborne lead concentrations do not meet or exceed action level outside of lead control area.
E. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems supplying exhausting, and passing through lead control areas. Seal HVAC inlets and outlet within lead control area with 6-mil plastic sheet and tape. Tape seal seams in HVAC components passing through lead control area.
F. Change Room and Shower Facilities: Provide clean change rooms and shower facilities within physical boundary around lead control area according to 29 CFR Part 1926.62.
G. Mechanical Ventilation System:
   1. Provide ventilation system to control personnel exposure to lead using HEPA equipped negative air machines.
   2. Design, construct, install, and maintain HEPA filtered fixed local exhaust ventilation system according to ANSI Z9.2 and approved by CIH.
   3. Exhaust ventilation air to exterior wherever possible.

4. When exhaust ventilation air must be recirculated into work area, provide HEPA filter with reliable back-up filter and controls to monitor lead concentration in return air and to bypass recirculation system automatically when system fails.

H. Personnel Protection: Provide and use required protective clothing and equipment within lead control area.

I. Warning Signs: Provide warning signs complying with 29 CFR Part 1926.62 at lead control area approaches. Locate signs so personnel read signs and take necessary precautions before entering lead control area.

3.3 WORK PROCEDURES

A. Remove lead-based paint according to approved lead-based paint removal plan.

1. Perform work only in presence of CIH or Industrial Hygienist (IH) Technician under direction of CIH ensuring continuous inspection of work in progress and direction of air monitoring activities.
2. Handle, store, transport, and dispose lead or and lead contaminated waste according to 40 CFR Part 260, 40 CFR Part 261, 40 CFR Part 262, 40 CFR Part 263, 40 CFR Part 264, and 40 CFR Part 265. Comply with land disposal restriction notification requirements as required by 40 CFR Part 268.

B. Use procedures and equipment required to limit occupational and environmental lead exposure when lead-based paint is removed according to 29 CFR Part 1926.62.

C. Dispose removed paint and waste according to Environmental Protection Agency (EPA), federal, state, and local requirements.

D. Personnel Exiting Procedures:

1. When personnel exit lead control area, comply with the following procedures:
   a. Vacuum exposed clothing surfaces.
   b. Remove protective clothing and equipment in decontamination room. Place clothing in approved impermeable disposal bag.
   c. Shower.
   d. Dress in clean clothes before leaving lead control area.

E. Monitoring - General:

1. Monitor airborne lead concentrations according to 29 CFR Part 1910.1025by testing laboratory as directed by CIH.

2. Take personal air monitoring samples on employees anticipated to have greatest exposure risk as determined by CIH. Additionally, take air monitoring samples on minimum 25 percent of work crew or minimum of two employees, whichever is greater, during each work shift.
3. Submit results of air monitoring samples, signed by CIH, within 24 hours after taking air samples. Notify Contracting Officer's Representative immediately of lead exposure at or exceeding action level outside of lead control area.

F. Monitoring During Paint Removal:
1. Perform personal and area monitoring during entire paint removal operation.
2. Conduct area monitoring at physical boundary daily for each work shift to ensure unprotected personnel are not exposed above action level anytime.
3. For outdoor operations, take at least one sample on each shift leeward of lead control area. When adjacent areas are contaminated, clean area of contamination and have CIH visually inspect and certify lead contamination is cleaned.
4. Stop work when outside boundary lead levels meet or exceed action level. Notify Contracting Officer's Representative, immediately.
5. Correct conditions causing increased lead concentration as directed by CIH.
6. Review sampling data collected during work stoppage to determine if conditions require additional work method modifications as determined by CIH.
7. Resume paint removal when approved by CIH.

3.4 LEAD-BASED PAINT REMOVAL

A. Remove paint within areas indicated on drawings completely exposing substrate. Minimize damage to substrate.
B. Comply with paint removal processes described lead paint removal plan.
C. Lead-Based Paint Removal: Select processes for each application to minimize work area lead contamination and waste.

3.5 FIELD QUALITY CONTROL

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
B. Perform sampling and testing for:
1. Air monitoring.
2. Lead-Based Paint.

3.6 CLEANING AND DISPOSAL

A. Cleaning:
   1. Maintain lead control area surfaces free of accumulating paint chips and dust. Confine dust, debris, and waste to work area.
   2. HEPA vacuum clean and wet wipe with detergent solution work area daily, at end of each shift, and when paint removal operation is complete.

B. CIH Certification: Certify in writing that inside and outside lead control area air monitoring samples are less than action level, employee respiratory protection was adequate, the work was performed according to 29 CFR Part 1926.62, and no visible accumulations of lead-based paint and dust remain on worksite.
   1. Do not remove lead control area or roped-off boundary and warning signs before Contracting Officer's Representative's receipt of CIH's certification.
   2. Re-clean areas showing dust or residual paint chips.

C. Testing: Where indicated and when directed by Contracting Officer's Representative, test lead-based paint residue and used abrasive according to 40 CFR Part 261 for hazardous waste.

D. Waste Collection:
   1. Collect lead-contaminated materials including waste, scrap, debris, bags, containers, equipment, and clothing, which may produce airborne lead contamination.
   2. Place lead contaminated materials in waste disposal drums. Label each drum identifying waste type according to 49 CFR Part 172 and date waste materials were first put into drum. Obtain and complete the Uniform Hazardous Waste Manifest forms. Comply with land disposal restriction notification requirements required by 40 CFR Part 268:
   3. Coordinate temporary storage location on project site with Contracting Officer's Representative.

E. Waste Disposal:
   1. Minimum 14 days before delivery, notify Contracting Officer's Representative who will arrange for job site inspection of drums and manifests by paint disposal facility personnel.
   2. Contracting Officer's Representative will arrange hazardous wastes removal, transport and delivery to paint disposal facility to ensure drums do not remain on project site longer than 90 calendar days from drum label date.

F. Waste Disposal:

1. Do not store hazardous waste drums in temporary storage location longer than 90 calendar days from drum label date.
2. Remove, transport, and deliver drums to paint disposal facility.
    a. Obtain signed receipt including date, time, quantity, and description of materials received according to 40 CFR Part 262.
    b. Obtain final report of materials disposition after disposal completion.

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SECTION 03 55 11
GYPSUM CONCRETE FLOOR DECKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section specifies gypsum plank systems for fire rated interstitial decks

B. Optional system for interstitial decks.

1.2 RELATED WORK

A. Section 05 12 00, STRUCTURAL STEEL FRAMING: Steel Framing.

B. Section 09 91 00, PAINTING: Sealer for interstitial floor and floor paint for traffic area in interstitial space.

1.3 QUALITY CONTROL

A. Work performed by experienced, qualified installers approved by manufacturer of gypsum plank.

B. Gypsum materials products of one manufacturer.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval.

B. Fire Tests: Fire tests, data and certifications substantiating that Gypsum Plank Decking complies with fire rating requirements.

C. Shop Drawings: Show typical plank layouts, perimeter and framed opening supports and details of construction, installation, fastenings and grouting.

D. Manufacturer's Literature and Data: Each item specified.

E. Load tables for sub-purlins.

F. Sustainable Construction Submittals.

G. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

1.5 DELIVERY AND STORAGE

A. Deliver materials in original packages, containers, or bundles bearing brand name and name of manufacturer.

B. Store materials in a manner that prevents damage before use. When stored under tarpaulins, provide ventilation to prevent moisture accumulation under tarpaulin.

C. Store gypsum planks flat and off ground. Handle and stack in a manner to prevent damage to face, ends, and edges and keep dry until used.

D. Store gypsum concrete off ground and keep dry until used.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designations only.

B. ASTM International(ASTM):

A36/A36M-19 .....Standard Specification for Carbon Structural Steel

A499-15(2020) .....Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails

A568/A568M-19a.....Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A653/A653M-20 .....Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C317/C317M-00(2019) .....Standard Specification for Gypsum Concrete

C1396/C1396M-17.....Standard Specification for Gypsum Board

E119-20 .....Standard Test Methods for Fire Tests of Building Construction and Materials

C. American Welding Society Publication (AWS):

D1.1/D1.1M-20 .....Structural Welding Code - Steel

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sub-purlins:

1. Open web truss-tees, hot-rolled bulb-tees or folded sheet metal tees as required by design loads, spans and fire ratings.
2. Flanges: Provide 16 mm (5/8-inch) minimum bearing for gypsum planks.
3. Galvanize or factory coat sub-purlins with manufacturer's standard primer.
4. Open web truss-tees: Fabricate from cold-formed steel wire conforming to ASTM A1064.
5. Hot-rolled bulb-tees: Rail-shaped, fabricated from hot-rolled steel conforming to ASTM A36 or ASTM A499.

6. Folded sheet metal tees: Fabricate from sheet steel conforming to ASTM A653 and ASTM A568.

B. Cross-Tees:

1. Cold-Formed, Fabrication from sheet steel conforming to ASTM A525 or ASTM A568.
2. Size: 30 mm (1-1/4-inches) by 13 mm (1/2-inch) by 0.6 mm (0.023-inch) thick by 600 mm (24-inches) long.

C. Gypsum Deck Plank:

1. Fabricated of gypsum board: ASTM C1396.
2. Nominal Size: 50 mm (2-inches) thick by 600 mm (24-inches) wide by main purlin span. Where possible, length should span two main purlin spans.
3. Factory laminate from two 25 mm (1-inch) thick gypsum panels with top panel edge set back along sub-purlin edge not more than 13 mm (1/2-inch).
4. Edge encased in water-resistant paper.

D. Gypsum Deck Panels: ASTM C1396, Type "X", 16 mm (5/8-inch) thick by 600 mm (24-inches) wide by main purlin span.

E. Grout: Gypsum Concrete: ASTM C317, Class A, 3.5 MPa (500 psi) minimum compressive strength.

2.2 DECK SYSTEM

A. Interstitial deck: Provide two-hour fire rating as tested by Gypsum plank manufacturer under ASTM E119 fire test conditions modified to simulate the Department of Veterans Affairs Building System test described in National Institute of Standards and Technology Report NBSIR 85-3158, "Fire Performance of Interstitial Space Construction System".

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrates, framing and conditions under which gypsum plank is to be installed and notify COR in writing of conditions detrimental to proper and timely completion.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Weld per AWS D1.1.

B. Sub-purlins:

1. Space at approximately 650 mm (24-5/8-inches) on center to provide minimum 16 mm (5/8-inch) continuous bearing for gypsum plank or deck.

2. Install framing of openings.
3. Touch up welds with same type of rust-inhibitive paint used for primer.

C. Provide continuous 16 mm (5/8-inch) minimum bearing for plank support at deck perimeter, plank ends and openings exceeding 200 mm (8-inches).

D. Grout:

1. Mix gypsum concrete thoroughly using a minimum amount of water to form a thick, pourable consistency.
2. Fill edge joints to slight excess with single pour at sub-purlins.
   a. Grout end joints on single span system against steel framing.
   b. After initial set, strike of excess to form smooth, flush joint.

E. Patching:

1. Fill with grout and smooth any surface damage to gypsum plank.
2. Remove and replace cracked, broken, and plank damaged beyond repair.

F. Cleaning and Protection:

1. Upon completion of gypsum plank decking, remove, debris and sweep surface clean. Leave ready for subsequent work.
2. Protect finished deck from weather and subsequent construction operations.
3. Provide hardboard or plywood temporary protection over decking subject to repetitive impact or wheeled loads.

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel shapes, plates, and bars.
2. Bolts, nuts, and washers.

1.2 RELATED REQUIREMENTS

A. Materials Testing And Inspection During Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Steel Framing:

1.3 APPLICABLE PUBLICATIONS

Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below

A. Comply with references to extent specified in this section.

B. American Institute of Steel Construction (AISC):

1. AISC Manual - Steel Construction Manual, 14th Ed.
2. 360-16: Specification for Structural Steel Buildings.

C. American Welding Society (AWS):

1. D1.1/D1.1M-15 - Structural Welding Code - Steel.

D. ASTM International (ASTM):

1. A6/A6M-14 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A36/A36M-14 - Carbon Structural Steel.
3. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
4. A500/A500M-13 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
5. A572/A572M-15 - High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
6. A992/A992M-15 - Structural Shapes.
7. F2329/F2329M-15 - Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy steel Bolts, Screws, washers, Nuts, and Special Threaded Fasteners.

8. F3125/F3125M-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

E. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1926.752(e) - Guidelines For Establishing The Components Of A Site-Specific Erection Plan.
2. 29 CFR 1926-2001 - Safety Standards for Steel Erection.

F. Research Council on Structural Connections (RCSC)

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Sustainable Construction Submittals:

D. Test Reports: Certify products comply with specifications.

1. Welders' qualifying tests.

E. Certificates: Certify each product complies with specifications.

1. Structural steel.
2. Steel connections.
3. Welding materials.
4. Shop coat primer paint.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Fabricator
2. Installer
3. Welders and welding procedures.

G. Delegated Design Drawings and Calculations: Signed and sealed by responsible Architect/Engineer.

1. Connection calculations.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: AISC Quality Certification participant designated as AISC Certified Plant, Category STD.

1. Regularly fabricates specified products.

2. Fabricated specified products with satisfactory service on five similar installations for minimum five years.

B. Installer Qualifications: AISC Quality Certification Program participant designated as AISC-Certified Erector, Category ACSE.

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.

C. Before commencement of Work, ensure steel erector provides written notification required by OSHA 29 CFR 1926.752(e). Submit a copy of the notification to Contracting Officer's Representative.

D. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.

1.6 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 MATERIALS

A. W-Shapes:

1. ASTM A992/A992M.
2. ASTM A572/A572M; Grade 50

B. Channel and Angles:

1. ASTM A36/A36M.

C. ASTM A572/A572M; Grade 50 Plates and Bars:

1. ASTM A36/A36M.
2. ASTM A572/A572M; Grade 50

D. Hollow Structural Sections:

1. ASTM A500/A500M.
2. ASTM A501/A501M.

E. Bolts, Nuts and Washers:

1. High-strength bolts, including nuts and washers: ASTM F3125.
2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.

3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ASME B18.22.1.

F. Welding Materials: AWS D1.1, type to suit application.

2.2 PRODUCTS - GENERAL

A. Sustainable Construction Requirements:

1. Steel Recycled Content: 30 percent total recycled content, minimum.
2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   a. Paints and coatings.

2.3 FABRICATION

A. Fabricate structural steel according to Chapter M, AISC 360.

B. Shop and Field Connections:

1. Weld connections according to AWS D1.1/D1.1M. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
2. High-Strength Bolts: High-strength bolts tightened to a bolt tension minimum 70 percent of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

2.4 FINISHES

A. Shop Priming:

1. Prime paint structural steel according to AISC 303, Section 6.
   a. Interstitial Space Structural Steel: Prime paint, unless indicated to receive sprayed on fireproofing.

2.5 ACCESSORIES

PART 3 - EXECUTION

3.1 ERECTION

A. Erect structural steel according to AISC 303 and AISC 360.

B. Set structural steel accurately at locations and elevations indicated on drawings.

C. Maintain erection tolerances of structural steel within AISC 303 requirements.

D. Weld and bolt connections as specified for shop connections.

3.2 FIELD PAINTING

A. After welding, clean and prime weld areas to match adjacent finish.

3.3 FIELD QUALITY CONTROL

A. Record Survey:

1. Engage registered land surveyor or registered civil engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS to perform survey.
2. Measure and record structural steel framing plumbness, level, and alignment after completing bolting and welding and before installation of work supported by structural steel.
3. Identify deviations from allowable tolerances specified in AISC Manual.

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SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:

1. Steel joists.

1.2 RELATED WORK

A. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Section 05 12 00, STRUCTURAL STEEL FRAMING: Structural steel framing.

C. Section 09 22 16, NON-STRUCTURAL METAL FRAMING: Non-load-bearing metal stud framing assemblies.

D. Section 09 29 00, GYPSUM BOARD: Gypsum board assemblies.

1.3 DESIGN REQUIREMENTS

A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

B. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the minimum physical and structural properties indicated.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval

B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.

C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Iron and Steel Institute (AISI): Specification and Commentary for the Design of Cold-Formed Steel Structural Members (2016)

C. ASTM International (ASTM):

A36/A36M-19 .....Standard Specification for Carbon Structural Steel

A123/A123M-17 .....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-16a.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A307-14e1.....Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A653/A653M-20 .....Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C955-18e1 .....Standard Specification for Cold Formed Steel Structural Framing Members

C1107/1107M-20.....Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

E488/E488M-18 .....Standard Test Methods for Strength of Anchors in Concrete Elements

E1190-11(2018).....Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):

D1.3/D1.3M-18 .....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing Repair

F. VA Physical Security and Resiliency Design Manual October 1, 2020.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel for joists, studs and accessories 16 gauge and heavier: ASTM A653, structural steel, zinc coated CP60 , with a yield of 340 MPa (50 ksi) minimum.

B. Sheet Steel for joists, studs and accessories 18 gauge and lighter: ASTM A653, structural steel, zinc coated G60 , with a yield of 230 MPa (33 ksi) minimum.

C. Galvanizing Repair Paint: MIL-P-21035B.

D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

2.2 WALL FRAMING

A. Steel Studs: Complying with ASTM C 955. Manufacturer's standard C-shaped steel studs of web depth indicated, with lipped flanges, and complying with the following: per drawings

2.3 JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, unpunched, of web depths indicated, with lipped flanges, and complying with the following: per drawings

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, unpunched, of web depths indicated, with straight flanges, and complying with the following:

2.4 DESIGN THICKNESS: MATCHING STEEL JOISTS. FRAMING ACCESSORIES

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Gusset plates.
5. Deflection track and vertical slide clips.
6. Stud kickers and girts.
7. Joist hangers and end closures.
8. Reinforcement plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.6 REQUIREMENTS

A. Welding in accordance with AWS D1.3

B. Furnish members and accessories by one manufacturer only.

PART 3 - EXECUTION

3.1 FABRICATION

A. Framing components may be preassembled into panels. Panels shall be square with components attached.

B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.

C. Hold members in place until fastened.

D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.

E. Where required, provide specified insulation in double header members and double jamb studs which will not be accessible after erection.

3.2 ERECTION

A. Handle and lift prefabricated panels in a manner as to not distort any member.

B. Securely anchor tracks to supports as shown.

C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.

D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.

F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.

G. Install headers in all openings that are larger than the stud spacing in that wall.

H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.

I. Studs in one piece for their entire length, splices will not be permitted.

J. Provide a load distribution member at top track where joist is not located directly over bearing stud.

K. Provide joist bridging and web stiffeners at reaction points where shown.

L. Provide end blocking where joist ends are not restrained from rotation.

M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.

N. Provide temporary bracing and leave in place until framing is permanently stabilized.

O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.

P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.3 TOLERANCES

A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.

B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.

C. Spacing of studs shall not be more than 3 mm (1/8 inch) +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

D. Prefabricated panels shall be not more than 3 mm (1/8 inch) +/- out of square within the length of that panel.

3.4 FIELD REPAIR

A. Touch-up damaged galvanizing with galvanizing repair paint.

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.2 RELATED WORK:

A. Sustainable design requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Postconsumer and preconsumer recycled content as specified in PART 2 - PRODUCTS.
2. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
3. For composite wood products, submit documentation indicating that product contains no added urea formaldehyde.

C. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

D. Manufacturer’s Literature and Data:

1. Submit data for lumber, panels, hardware and adhesives.
2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
3. Submit data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
4. For products receiving a waterborne treatment, submit statement that moisture content of treated materials was reduced to levels specified before shipment to project site.

E. Manufacturer’s certificate for unmarked lumber.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 152 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 QUALITY ASSURANCE:

A. Installer: A firm with a minimum of three (3) years' experience in the type of work required by this section.

1.6 GRADING AND MARKINGS:

A. Any unmarked lumber or plywood panel for its grade and species will not be allowed on VA Construction sites for lumber and material not normally grade marked, provide manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material meet the specified the specified requirements.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Forest and Paper Association (AFPA):

NDS-15 .....National Design Specification for Wood Construction

WCD1-01 .....Details for Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):

A190.1-07.....Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):

B18.2.1-12(R2013) .....Square and Hex Bolts and Screws

B18.2.2-10.....Square and Hex Nuts

B18.6.1-81(R2008) .....Wood Screws

E. American Plywood Association (APA):

E30-11 .....Engineered Wood Construction Guide

F. ASTM International (ASTM):

A653/A653M-13 .....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-11 ..... Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness

C1002-14 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D198-14..... Test Methods of Static Tests of Lumber in Structural Sizes

D2344/D2344M-13 ..... Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

D2559-12a..... Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions

D3498-03(R2011)..... Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

D6108-13..... Test Method for Compressive Properties of Plastic Lumber and Shapes

D6109-13..... Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products

D6111-13a..... Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement

D6112-13..... Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes

F844-07a(R2013)..... Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-13 ..... Nails, Spikes, and Staples

G. American Wood Protection Association (AWPA):

AWPA Book of Standards

H. Commercial Item Description (CID):

A-A-55615 ..... Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Forest Stewardship Council (FSC):

FSC-STD-01-001(Ver. 4-0)FSC Principles and Criteria for Forest Stewardship

J. Military Specification (Mil. Spec.):

MIL-L-19140E ..... Lumber and Plywood, Fire-Retardant Treated

K. Environmental Protection Agency (EPA):

40 CFR 59(2014) ..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

L. Truss Plate Institute (TPI):

TPI-85 ..... Metal Plate Connected Wood Trusses

M. U.S. Department of Commerce Product Standard (PS)

PS 1-95 ..... Construction and Industrial Plywood

PS 20-10 ..... American Softwood Lumber Standard

N. ICC Evaluation Service (ICC ES):

AC09 ..... Quality Control of Wood Shakes and Shingles

AC174 ..... Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)

PART 2 - PRODUCTS

2.1 LUMBER:

A. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
   1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
   2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Structural Members: Species and grade as listed in the AFPA NDS having design stresses as shown.

C. Lumber Other Than Structural:
   1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
   2. Framing lumber: Minimum extreme fiber stress in bending of 7584 kPa (1100 PSI).
   3. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.
   4. Board Sub-flooring: Shiplap edge, 25 mm (1 inch) thick, not less than 203 mm (8 inches) wide.

D. Sizes:
   1. Conforming to PS 20.
   2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

E. Moisture Content:
   1. Maximum moisture content of wood products is to be as follows at the time of delivery to site.
      a. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
      b. Lumber over 50 mm (2 inches) thick: 25 percent or less.

F. Fire Retardant Treatment:
   1. Comply with Mil Spec. MIL-L-19140.
   2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

G. Preservative Treatment:
   1. Do not treat Heart Redwood and Western Red Cedar.
   2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 610 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members provided in connection with roofing and flashing materials.
   3. Treat other members specified as preservative treated (PT).
   4. Preservative treat by the pressure method complying with AWPA Book use category system standards U1 and T1, except any process involving the use of Chromated Copper Arsenate (CCA) or other agents classified as carcinogenic for pressure treating wood is not permitted.

2.2 PLYWOOD:

A. Comply with PS 1.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

C. Sheathing:
   1. APA rated Exposure 1 or Exterior; panel grade CD or better.
   2. Wall sheathing:

a. Minimum 9 mm (11/32 inch) thick with supports 406 mm (16 inches) on center and 12 mm (15/32 inch) thick with supports 610 mm (24 inches) on center unless specified otherwise.
b. Minimum 1200 mm (48 inches) wide at corners without corner bracing of framing.

2.3 ROUGH HARDWARE AND ADHESIVES:

A. Anchor Bolts:
1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.

C. Washers
1. ASTM F844.
2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:
1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

E. Nails:
1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
2. ASTM F1667:
a. Common: Type I, Style 10.
b. Concrete: Type I, Style 11.
c. Barbed: Type I, Style 26.
d. Underlayment: Type I, Style 25.
e. Masonry: Type I, Style 27.
f. Provide special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.

F. Framing and Timber Connectors:

1. Fabricate of ASTM A653/A653M, Grade A; steel sheet not less than 1.3 mm (0.052 inch) thick unless specified otherwise. Apply standard plating to steel timber connectors after punching, forming and assembly of parts.
2. Framing Angles: Angle designed with bendable legs to provide three (3) way anchors.
3. Straps:
   a. Designed to provide wind and seismic ties with sizes as shown or specified.
   b. Strap ties not less than 32 mm (1-1/4 inches) wide.
   c. Punched for fastener.

G. Adhesives:
1. For field-gluing plywood to lumber framing floor or roof systems: ASTM D3498.
2. For structural laminated Wood: ASTM D2559.
3. Adhesives to have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:

A. Conform to applicable requirements of the following:
1. AFPA NDS for timber connectors.
2. AITC A190.1 Timber Construction Manual for heavy timber construction.
3. AFPA WCD1 for nailing and framing unless specified otherwise.
4. APA for installation of plywood or structural use panels.
5. TPI for metal plate connected wood trusses.

B. Fasteners:
1. Nails.
   a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA WCD1 where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
   b. Use special nails with framing connectors.
   c. For sheathing and subflooring, select length of nails sufficient to extend 25 mm (1 inch) into supports.
   d. Use 8d or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.

e. Use 16d or larger nails for nailing through 50 mm (2 inch) thick lumber.

f. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.

g. Nailing Schedule; Using Common Nails:

1) Joist bearing on sill or girder, toe nail three (3) 8d nails or framing anchor.

2) Bridging to joist, toe nail each end two (2) 8d nails.

3) Ledger strip to beam or girder three (3) 16d nails under each joint.

4) Subflooring or Sheathing:

a) 152 mm (6 inch) wide or less to each joist face nail two (2) 8d nails.

b) Subflooring, more than 152 mm (6 inches) wide, to each stud or joint, face nail three (3) 8d nails.

c) Plywood or structural use panel to each stud or joist face nail 8d, at supported edges 152 mm (6 inches) on center and at intermediate supports 254 mm (10 inches) on center. When gluing plywood to joint framing increase nail spacing to 305 mm (12 inches) at supported edges and 508 mm (20 inches) o.c. at intermediate supports.

5) Sole plate to joist or blocking, through sub floor face nail 20d nails, 406 mm (16 inches) on center.

6) Top plate to stud, end nail two (2) 16d nails.

7) Stud to sole plate, toe nail or framing anchor. Four (4) 8d nails.

8) Doubled studs, face nail 16d at 610 mm (24 inches) on center.

9) Built-up corner studs 16d at 610 mm (24 inches) (24 inches) on center.

10) Doubled top plates, face nails 16d at 406 mm (16 inches) on center.

11) Top plates, laps, and intersections, face nail two (2) 16d.

12) Continuous header, two pieces 16d at 406 mm (16 inches) on center along each edge.

13) Ceiling joists to plate, toenail three (3) 8d or framing anchor.

14) Continuous header to stud, four (4) 16d.

15) Ceiling joists, laps over partitions, face nail three (3) 16d or framing anchor.

16) Ceiling joists, to parallel rafters, face nail three (3) 16d.

17) Rafter to plate, toe nail three (3) 8d or framing anchor. Brace 25 mm (1 inch) thick board to each stud and plate, face nail three (3) 8d.

18) Built-up girders and beams 20d at 812 mm (32 inches) on center along each edge.

2. Bolts:
   a. Fit bolt heads and nuts bearing on wood with washers.
   b. Countersink bolt heads flush with the surface of nailers.
   c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
   d. Provide toggle bolts to hollow masonry or sheet metal.
   e. Provide bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 610 mm (24 inch) intervals between end bolts. Provide clips to beam flanges.
3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
   a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
   b. ASTM C954 for steel over 0.84 mm (0.033 inch) thick.
4. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
6. Screws to Join Wood:
   a. Where shown or option to nails.
   b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
   c. Spaced same as nails.
7. Installation of Timber Connectors:
   a. Conform to applicable requirements of the AFPA NDS.
   b. Fit wood to connectors and drill holes for fasteners so wood is not split.

C. Set sills or plates level in full bed of mortar on masonry or concrete walls.
   1. Space anchor bolts 1219 mm (4 feet) on centers between ends and within 152 mm (6 inches) of end. Stagger bolts from side to side on plates over 178 mm (7 inches) in width.
   2. Provide shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
   3. Closely fit, and set to required lines.

D. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

E. Blocking Nailers, and Furring:

1. Install furring, blocking, nailers, and grounds where shown.
2. Provide longest lengths practicable.
3. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
4. Layers of Blocking or Plates:
   a. Stagger end joints between upper and lower pieces.
   b. Nail at ends and not over 610 mm (24 inches) between ends.
   c. Stagger nails from side to side of wood member over 127 mm (5 inches) in width.
5. Unless otherwise shown, provide wall furring 25 mm by 75 mm (1 inch by 3 inch) continuous wood strips installed plumb on walls, using wood shims where necessary so face of furring forms a true, even plane. Space furring not over 406 mm (16 inches) on centers, butt joints over bearings and rigidly secure in place. Anchor furring on 406 mm (16 inches) centers.

F. Sheathing:

1. Provide plywood or structural-use panels for sheathing.
2. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
3. Set nails not less than 9 mm (3/8 inch) from edges.
4. Install 50 mm by 101 mm (2 inch by 4 inch) blocking spiked between joists, rafters and studs to support edge or end joints of panels.
5. Match and align sheathing which is an extension of work in place to existing.

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SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

B. Provide UL or equivalent approved firestopping system for the closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 07 92 00, JOINT SEALANTS: Sealants and application.

C. Section 23 31 00, HVAC DUCTS AND CASINGS: Fire and smoke damper assemblies in ductwork.

D. Section 23 37 00, AIR OUTLETS AND INLETS: Fire and smoke damper assemblies in ductwork.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Installer qualifications.

C. Inspector qualifications.

D. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.

E. List of FM, UL, or WH classification number of systems installed.

F. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

G. Submit certificates from manufacturer attesting that firestopping materials comply with the specified requirements.

1.4 DELIVERY AND STORAGE

A. Deliver materials in their original unopened containers with manufacturer’s name and product identification.

B. Store in a location providing protection from damage and exposure to the elements.

1.5 QUALITY ASSURANCE

A. FM, UL, or WH or other approved laboratory tested products will be acceptable.

B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements." Submit qualification data.

C. Inspector Qualifications: Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years' experience in construction field inspections of firestopping systems, products, and assemblies. The inspector to be completely independent of, and divested from, the Contractor, the installer, the manufacturer, and the supplier of material or item being inspected. Submit inspector qualifications.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

E84-20 ..... Surface Burning Characteristics of Building Materials

E699-16 ..... Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components

E814-13a(2017)..... Fire Tests of Penetration Firestop Systems

E2174-20a ..... Standard Practice for On-Site Inspection of Installed Firestop Systems

E2393-20 ..... Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

C. FM Global (FM):

Annual Issue Approval Guide Building Materials

4991-13 ..... Approval of Firestop Contractors

D. Underwriters Laboratories, Inc. (UL):

Annual Issue Building Materials Directory

E. Annual Issue Fire Resistance Directory

723-Edition 11(2018) ..... Standard for Test for Surface Burning Characteristics of Building Materials

1479-04(2015)..... Fire Tests of Penetration Firestops

F. Intertek Testing Services - Warnock Hersey (ITS-WH):
Annual Issue Certification Listings

G. Environmental Protection Agency (EPA):
40 CFR 59(2014).....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS

A. Provide either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke. Firestop systems to accommodate building movements without impairing their integrity.

B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 101 mm (4 inches) nominal pipe or 0.01 square meter (16 square inches) in overall cross-sectional area.

C. Firestop sealants used for firestopping or smoke sealing to have the following properties:
   1. Contain no flammable or toxic solvents.
   2. Release no dangerous or flammable out gassing during the drying or curing of products.
   3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
   4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

D. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials to have following properties:
   1. Classified for use with the particular type of penetrating material used.
   2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.

E. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.

F. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.

G. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and to not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.

H. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 101 mm (4 inches) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

A. Provide silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.

B. Provide mineral fiber filler and bond breaker behind sealant.

C. Sealants to have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with ASTM E84.

D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Submit product data and installation instructions, as required by article, submittals, after an on-site examination of areas to receive firestopping.

B. Examine substrates and conditions with installer present for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting

performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, grease, oil, laitance and form-release agents from concrete, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.

B. Remove insulation on insulated pipe for a distance of 150 mm (6 inches) on each side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

C. Prime substrates where required by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Apply masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 INSTALLATION

A. Do not begin firestopping work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.

C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP

A. As work on each floor is completed, remove materials, litter, and debris.

B. Clean up spills of liquid type materials.

C. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

D. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to provide firestopping complying with specified requirements.

3.5 INSPECTIONS AND ACCEPTANCE OF WORK

A. Do not conceal or enclose firestop assemblies until inspection is complete and approved by the Contracting Officer Representative (COR).

B. Furnish service of approved inspector to inspect firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results. Submit written reports indicating locations of and types of penetrations and type of firestopping used at each location; type is to be recorded by UL listed printed numbers.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section covers interior and exterior sealant and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK (INCLUDING BUT NOT LIMITED TO THE FOLLOWING):

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Sealing of Site Work Concrete Paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

C. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.

D. Mechanical Work: Section 22 05 11 COMMON WORK RESULTS FOR PLUMBING and Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer with a minimum of three (3) years' experience and who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance. Submit qualification.

B. Source Limitations: Obtain each type of joint sealant through one (1) source from a single manufacturer.

C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Lab Tests: Submit samples of materials that will be in contact or affect joint sealants to joint sealant manufacturers for tests as follows:

1. Adhesion Testing: Before installing elastomeric sealants, test their adhesion to protect joint substrates according to the method in ASTM C794 to determine if primer or other specific joint preparation techniques are required.
2. Compatibility Testing: Before installing elastomeric sealants, determine compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Perform testing per ASTM C1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work is to start until results of these tests have been submitted to the Contracting Officer Representative (COR) and the COR has given written approval to proceed with the work.

1.4 CERTIFICATION:

A. Contractor is to submit to the COR written certification that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vapor tight seals (as applicable), and that materials supplied meet specified performance requirements.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Installer qualifications.

C. Contractor certification.

D. Manufacturer's installation instructions for each product used.

E. Cured samples of exposed sealants for each color.

F. Manufacturer's Literature and Data:

1. Primers
2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

G. Manufacturer warranty.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following conditions:
   a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C (40 degrees F).
   b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 DELIVERY, HANDLING, AND STORAGE:

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures exceeding 32 degrees C (90 degrees F) or less than 5 degrees C (40 degrees F).

1.8 DEFINITIONS:

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Backing Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.9 WARRANTY:

A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".

B. Manufacturer Warranty: Manufacturer shall warranty their sealant for a minimum of five (5) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.10 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. ASTM International (ASTM):

C509-06 ..... Elastomeric Cellular Preformed Gasket and Sealing Material

C612-14 ..... Mineral Fiber Block and Board Thermal Insulation

C717-14a ..... Standard Terminology of Building Seals and Sealants

C734-06(R2012) ..... Test Method for Low-Temperature Flexibility of Latex Sealants after Artificial Weathering

C794-10 ..... Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

C919-12. ..... Use of Sealants in Acoustical Applications.

C920-14a ..... Elastomeric Joint Sealants.

C1021-08(R2014) ..... Laboratories Engaged in Testing of Building Sealants

C1193-13 ..... Standard Guide for Use of Joint Sealants.

C1248-08(R2012) ..... Test Method for Staining of Porous Substrate by Joint Sealants

C1330-02(R2013) ..... Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants

C1521-13 ..... Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

D217-10..... Test Methods for Cone Penetration of Lubricating Grease

D1056-14..... Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

E84-09 ..... Surface Burning Characteristics of Building Materials

C. Sealant, Waterproofing and Restoration Institute (SWRI).

The Professionals' Guide

D. Environmental Protection Agency (EPA):

40 CFR 59(2014)..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SEALANTS:

A. Exterior Sealants:

1. Vertical surfaces, provide non-staining ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
2. Horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T.
3. Provide location(s) of exterior sealant as follows:
   a. Joints formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Provide sealant at exterior surfaces of exterior wall penetrations.
   b. Metal to metal.
   c. Masonry to masonry or stone.
   d. Stone to stone.
   e. Cast stone to cast stone.
   f. Masonry expansion and control joints.
   g. Wood to masonry.

h. Masonry joints where shelf angles occur.

i. Voids where items penetrate exterior walls.

j. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.

B. Floor Joint Sealant:

1. ASTM C920, Type S or M, Grade P, Class 25, Use T.
2. Provide location(s) of floor joint sealant as follows.

a. Seats of metal thresholds exterior doors.

b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

C. Interior Sealants:

1. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system are to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):

a. Architectural Sealants: 250 g/L.

b. Sealant Primers for Nonporous Substrates: 250 g/L.

c. Sealant Primers for Porous Substrates: 775 g/L.

2. Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
3. Provide location(s) of interior sealant as follows:

a. Typical narrow joint 6 mm, (1/4 inch) or less at walls and adjacent components.

b. Perimeter of doors, windows, access panels which adjoin concrete or masonry surfaces.

c. Interior surfaces of exterior wall penetrations.

d. Joints at masonry walls and columns, piers, concrete walls or exterior walls.

e. Perimeter of lead faced control windows and plaster or gypsum wallboard walls.

f. Exposed isolation joints at top of full height walls.

g. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplanar tile surfaces meet.

h. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.

i. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.

2.2 COLOR:

A. Sealants used with exposed masonry are to match color of mortar joints.

B. Sealants used with unpainted concrete are to match color of adjacent concrete.

C. Color of sealants for other locations to be light gray or aluminum, unless otherwise indicated in construction documents.

2.3 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056 or synthetic rubber (ASTM C509), nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32 degrees C (minus 26 degrees F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 WEEPS:

A. Weep/Vent Products: Provide the following unless otherwise indicated or approved.

1. Round Plastic Tubing: Medium-density polyethylene, 10 mm (3/8-inch) OD by thickness of stone or masonry veneer.

2.5 FILLER:

A. Mineral fiberboard: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.7 CLEANERS-NON POROUS SURFACES:

A. Chemical cleaners compatible with sealant and acceptable to manufacturer of sealants and sealant backing material. Cleaners to be free of oily residues and other substances capable of

staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

B. Coordinate for repair and resolution of unsound substrate materials.

C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS:

A. Prepare joints in accordance with manufacturer's instructions and SWRI (The Professionals' Guide).

B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.

1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include but are not limited to the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous surfaces include but are not limited to the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

C. Do not cut or damage joint edges.

D. Apply non-staining masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions or as indicated by pre-construction joint sealant substrate test.

1. Apply primer prior to installation of back-up rod or bond breaker tape.
2. Use brush or other approved means that will reach all parts of joints. Avoid application to or spillage onto adjacent substrate surfaces.

3.3 BACKING INSTALLATION:

A. Install backing material, to form joints enclosed on three sides as required for specified depth of sealant.

B. Where deep joints occur, install filler to fill space behind the backing rod and position the rod at proper depth.

C. Cut fillers installed by others to proper depth for installation of backing rod and sealants.

D. Install backing rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.

E. Where space for backing rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

3.4 SEALANT DEPTHS AND GEOMETRY:

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

A. General:

1. Apply sealants and caulking only when ambient temperature is between 5 degrees C and 38 degrees C (40 degrees and 100 degrees F).

2. Do not install polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
3. Do not install sealant type listed by manufacture as not suitable for use in locations specified.
4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
5. Avoid dropping or smearing compound on adjacent surfaces.
6. Fill joints solidly with compound and finish compound smooth.
7. Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C1193 unless shown or specified otherwise in construction documents. Remove masking tape immediately after tooling of sealant and before sealant face starts to “skin” over. Remove any excess sealant from adjacent surfaces of joint, leaving the working in a clean finished condition.
8. Finish paving or floor joints flush unless joint is otherwise detailed.
9. Apply compounds with nozzle size to fit joint width.
10. Test sealants for compatibility with each other and substrate. Use only compatible sealant. Submit test reports.
11. Replace sealant which is damaged during construction process.

B. Weeps: Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, at all flashing, and as indicated on construction documents.
1. Use round plastic tubing to form weep holes.
2. Space weep holes formed from plastic tubing not more than 406 mm (16 inches) o.c.
3. Trim tubing material used in weep holes flush with exterior wall face after sealant has set.

C. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise. Take all necessary steps to prevent three-sided adhesion of sealants.

D. Interior Sealants: Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.

2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cutouts to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
   a. Perform 10 tests for first 305 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform one test for each 305 m (1000 feet) of joint length thereafter or one test per each floor per elevation.

B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

C. Inspect tested joints and report on following:

1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
2. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
3. Whether sealants filled joint cavities and are free from voids.
4. Whether sealant dimensions and configurations comply with specified requirements.

D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING:

A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by manufacturer of the adjacent material or if not otherwise indicated by the caulking or sealant manufacturer.

B. Leave adjacent surfaces in a clean and unstained condition.

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SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hollow metal doors hung in hollow metal frames at interior locations.
2. Hollow metal door frames for wood doors at interior locations.

1.2 RELATED WORK

A. Section 08 34 53, SECURITY DOORS AND FRAMES: Forced Entry and Ballistic Resistant doors.

B. Section 08 71 00, DOOR HARDWARE: Door Hardware:

C. Card Readers and Biometric Devices: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

D. Security Monitors: Section 28 23 00, VIDEO SURVEILLANCE.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standard Institute (ANSI):

A250.8-2014.....Standard Steel Doors and Frames

C. ASTM International (ASTM):

A240/A240M-15b .....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A653/A653M-15 .....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip

A1008/A1008M-15 .....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate

B209M-14 .....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M-13 .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

D3656/D3656M-13 .....Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns

E90-09 ..... Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

D. Federal Specifications (Fed. Spec.):

L-S-125B ..... Screening, Insect, Nonmetallic

E. Master Painters Institute (MPI):

No. 18 ..... Primer, Zinc Rich, Organic

F. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06 ..... Metal Finishes Manual

G. National Fire Protection Association (NFPA):

80-16 ..... Fire Doors and Other Opening Protectives

H. UL LLC (UL):

10C-09 ..... Positive Pressure Fire Tests of Door Assemblies

1784-15 ..... Air Leakage Tests of Door Assemblies and Other Opening Protectives

I. Department of Veterans Affairs

VA Physical Security and Resiliency Design Manual October 1, 2020

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Include schedule showing each door and frame requirements and fire label for openings.
3. Installation instructions.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

E. Test reports: Certify each product complies with specifications.

1. Sound rated door.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Manufacturer with project experience list.

G. Blast Design Calculations.

1. Submit calculations for review and approval prepared by qualified blast consultant, with a minimum of 5 years of experience in design of blast resistant window systems, verifying door assembly including anchors comply with specified blast resistance performance. The magnitudes of the design threats W1, W2 and GP1, GP2 are defined in the Physical Security and Resiliency Design Standards Data Definitions which is a document separate from the referenced VA Security and Resiliency Design Manual. The Physical Security and Resiliency Design Standards Data Definitions are provided on a need-to-know basis by the structural blast specialist performing the blast design on VA projects. It is the responsibility of the delegated engineer responsible for the design of blast resistant doors to request and obtain the Physical Security and Resiliency Design Data Standard Data Definitions from the VA Office of Construction and Facilities Management (CFM). Any associated delays or increased costs due to failure to obtain this information will be borne by the contractor.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Regularly manufactures specified products.
   2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
      a. Project Experience List: Provide contact names and addresses for completed projects.

1.6 DELIVERY

A. Fasten temporary steel spreaders across the bottom of each door frame before shipment.
B. Deliver products in manufacturer's original sealed packaging.
C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.
B. Protect products from damage during handling and construction operations.

1.8 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design hollow metal doors and frames complying with specified performance:

1. Fire Doors and Frames: UL 10C; NFPA 80 labeled.

   a. Fire Ratings: See drawings.

2.2 MATERIALS

A. Sheet Steel: ASTM A1008/A1008M, cold-rolled.

B. Galvanized Sheet Steel: ASTM A653.

C. Insect Screening: ASTM D3656/D3656M, 18 by 18 aluminum wire mesh.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide hollow metal doors and frames from one manufacturer.

2.4 HOLLOW METAL DOORS

A. Hollow Metal Doors: ANSI A250.8; 44 mm (1-3/4 inches) thick. See drawings for sizes and designs.

1. Interior Doors: Level 1 and Physical Performance Level C, standard duty; Model 2, seamless.
2. Interior Doors: Level 2 and Physical Performance Level B, heavy duty; Model 2, seamless at all exterior locations.

B. Door Faces:

1. Interior Doors: Sheet steel minimum Z120 or ZF120 (G40 or A40), Z180 or ZF180 (G60 or A60) coating.

C. Door Cores:

1. Interior Doors: Kraft paper honeycomb.
2. Fire Doors: Manufacturer's standard complying with specified fire rating performance.

2.5 HOLLOW METAL FRAMES

A. Hollow Metal Frames: ANSI A250.8; face welded. See drawings for sizes and designs.

1. Interior Frames:

   a. Level 1 Hollow Metal Doors: 1.0 mm (0.042 inch) thick.

   b. Wood Doors: 1.0 mm (0.042 inch) thick.

B. Frame Materials:

1. Interior Frames: Sheet steel Z120 or ZF120 (G40 or A40) coating.

2.6 FABRICATION

A. Hardware Preparation: ANSI A250.8; for hardware specified in Section 08 71 00, DOOR HARDWARE.

B. Hollow Metal Door Fabrication:

1. Close top edge of exterior doors flush and seal to prevent water intrusion.
2. Fill spaces between vertical steel stiffeners with insulation.

C. Fire Doors:

1. Close top and vertical edges flush.
2. Apply steel astragal to active leaf at pair and double egress doors.
   a. Exception: Where vertical rod exit devices are specified for both leaves swinging in same direction.
3. Fire Door Clearances: NFPA 80.

D. Custom Metal Hollow Doors:

1. Provide custom hollow metal doors where nonstandard steel doors are shown on drawings.
   a. Provide door sizes, design, materials, construction, gauges, and finish as specified for standard steel doors.

E. Hollow Metal Frame Fabrication:

1. Fasten mortar guards to back of hardware reinforcements, except on lead-lined frames.
2. Concealed Closers in Head Frame: Provide 1 mm (0.042 inch) thick steel removable stop sections for access to concealed face plates and control valves, except when cover plates are furnished with closer.
3. Frame Anchors:
   a. Floor anchors:
      1) Provide extension type floor anchors to compensate for depth of floor fills.
      2) Provide 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive floor fasteners.
      3) Provide 50 mm by 50 mm by 9 mm (2 inch by 2 inch by 3/8 inch) clip angle for lead lined frames, drilled for floor fasteners.
      4) Provide mullion 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two floor fasteners and frame anchor screws.
      5) Provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for floor fasteners and frame anchor screws for sill sections.

a) Space floor bolts50 mm (24 inches) on center.

b. Jamb anchors:

1) Place anchors on jambs:

a) Near top and bottom of each frame.

b) At intermediate points at maximum 600 mm (24 inches) spacing.

2) Form jamb anchors from steel minimum 1 mm (0.042 inch) thick.

3) Anchors set in masonry: Provide adjustable anchors designed for friction fit against frame and extended into masonry minimum 250 mm (10 inches). Provide one of following types:

a) Wire Loop Type: 5 mm (3/16 inch) diameter wire.

b) T-Shape type.

c) Strap and stirrup type: Corrugated or perforated sheet steel.

4) Anchors for stud partitions: Provide tabs for securing anchor to sides of studs. Provide one of the following:

a) Welded type.

b) Lock-in snap-in type.

5) Anchors for frames set in prepared openings:

a) Steel pipe spacers 6 mm (1/4 inch) inside diameter, welded to plate reinforcing at jamb stops, or hat shaped formed strap spacers 50 mm (2 inches) wide, welded to jamb near stop.

b) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass through frame and spacers.

c) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.

6) Anchors for observation windows and other continuous frames set in stud partitions.

a) Weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.

b) Space maximum 600 mm (24 inches) on centers.

7) Modify frame anchors to fit special frame and wall construction.

8) Provide special anchors where shown on drawings and where required to suit application.

2.7 FINISHES

A. Steel: ANSI A250.8; shop primed.

B. Stainless Steel: NAAMM AMP 500; No. 4 polished finish.

1. Blend welds to match adjacent finish.

C. Finish exposed surfaces after fabrication.

D. Aluminum Anodized Finish: NAAMM AMP 500.

1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.
3. Clear Anodized Finish: AA-C22A31; Class II Architectural, 0.01 mm (0.4 mil) thick.
4. Color Anodized Finish: AA-C22A32 or AA-C22A34; Class II Architectural, 0.01 mm (0.4 mil) thick.

2.8 ACCESSORIES

A. Primers: ANSI A250.8.

B. Barrier Coating: ASTM D1187/D1187M.

C. Welding Materials: AWS D1.1/D1.1M, type to suit application.

D. Clips Connecting Members and Sleeves: Match door faces.

E. Fasteners: Galvanized steel.

1. Metal Framing: Steel drill screws.
2. Masonry and Concrete: Expansion bolts.

F. Anchors: Galvanized steel.

G. Galvanizing Repair Paint: MPI No. 18.

H. Insulation: Unfaced mineral wool.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Apply barrier coating to metal surfaces in contact with cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
2. Install fire doors and frames according to NFPA 80.
3. Install smoke control doors and frames according to NFPA 105.

3.3 FRAME INSTALLATION

A. Apply barrier coating to concealed surfaces of frames built into masonry.

B. Plumb, align, and brace frames until permanent anchors are set.

1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
2. Use wood spreaders at bottom of frame when shipping spreader is removed.
3. Where construction permits concealment, leave shipping spreaders in place after installation, otherwise remove spreaders when frames are set and anchored.
4. Remove wood spreaders and braces when walls are built and jamb anchors are secured.

C. Floor Anchors:

1. Anchor frame jambs to floor with two expansion bolts.
   a. Lead Lined Frames: Use 9 mm (3/8 inch) diameter bolts.
   b. Other Frames: Use 6 mm (1/4 inch) diameter bolts.
2. Power actuated drive pins are acceptable to secure frame anchors to concrete floors.

D. Jamb Anchors:

1. Masonry Walls:
   a. Embed anchors in mortar.
   b. Fill space between frame and masonry with grout or mortar as walls are built.
2. Metal Framed Walls: Secure anchors to sides of studs with two fasteners through anchor tabs.
3. Prepared Masonry and Concrete Openings:
   a. Direct Securement: 6 mm (1/4 inch) diameter expansion bolts through spacers.
   b. Subframe or Rough Buck Securement:
      1) 6 mm (1/4 inch) diameter expansion bolts on 600 mm (24 inch) centers.
      2) Power activated drive pins on 600 mm (24 inches) centers.
   c. Secure two-piece frames to subframe or rough buck with machine screws on both faces.

E. Frames for Sound Rated Doors: Fill frames with insulation.

F. Lead Lined Frames:

1. Extend jambs and anchor with clip angles to structure above.
    a. Fasteners to Concrete: Minimum two, 9 mm (3/8 inch) diameter expansion bolts.
    b. Connection to Structural Steel: Welded.

G. Touch up damaged factory finishes.
1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.4 DOOR INSTALLATION

A. Install doors plumb and level.

B. Adjust doors for smooth operation.

C. Touch up damaged factory finishes.
1. Repair galvanized surfaces with galvanized repair paint.
2. Repair painted surfaces with touch up primer.

3.5 CLEANING

A. Clean exposed door and frame surfaces. Remove contaminants and stains.

3.6 PROTECTION

A. Protect doors and frames from construction operations.

B. Remove protective materials immediately before acceptance.

C. Repair damage.

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SECTION 08 14 00
INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior flush wood doors painted finish.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Paints and Coatings and Composite Wood and Agrifiber VOC Limits.

B. Section 08 71 00, DOOR HARDWARE: Door Hardware including hardware location (height).

C. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES: Installation of Doors.

D. Section 08 71 00, DOOR HARDWARE: Installation of Door Hardware.

E. Section 09 06 00, SCHEDULE FOR FINISHES: Door Finish.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA):

1. I.S. 1A-13 - Architectural Wood Flush Doors.
2. I.S. 6A-13 - Interior Architectural Stile and Rails Doors.

C. ASTM International (ASTM):

1. E90-09(2016) - Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions and Elements.

D. National Fire Protection Association (NFPA):

1. 80-16 - Fire Doors and Other Opening Protectives.
2. 252-12 - Fire Tests of Door Assemblies.

E. UL LLC (UL):

1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.

F. Window and Door Manufacturers Association (WDMA):

1. TM 7-14 - Cycle-Slam Test.
2. TM 8-14 - Hinge Loading Test.
3. TM 10-14 - Screw Holding Capacity.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:
   1. Show size, configuration, and fabrication and installation details.
   2. Indicate project specific requirements not included in Manufacturer's Literature and Data submittal.
C. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Fire rated doors showing conformance with NFPA 80 .
D. Samples:
   1. Corner section of flush veneered door 300 mm (12 inches) square, showing details of construction, labeled to show grade and type number and conformance to specified standard.
   2. Veneer sample 200 mm by 275 mm (8 inch by 11 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.
E. Sustainable Construction Submittals:
   1. Low Pollutant-Emitting Materials:

      Show volatile organic compound types and quantities.
F. Test Reports: Indicate each product complies with specifications.
   1. Screw Holding Capacity Test.
   2. Cycle-Slam Test.
   3. Hinge-Loading Test.
G. Operation and Maintenance Data:
   1. Care instructions for each exposed finish product.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Regularly and presently manufactures specified products.
   2. Manufactures specified products with satisfactory service on five similar installations for minimum five years.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.
   1. Minimum 0.15 mm (6 mil) polyethylene bags or cardboard packaging to remain unbroken during delivery and storage.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, and manufacture date.
   1. Identify door opening corresponding to Door Schedule.
C. Before installation, return or dispose of products within distorted, damaged, or opened packaging. Retain packaging for door protection after installation.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.
   1. Store doors according to ANSI/WDMA I.S. 1A.
B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:
   1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
   2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
   3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

      Comply with door manufacturer's instructions for relative humidity.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
B. Manufacturer's Warranty: Warrant interior factory finished flush wood doors against material and manufacturing defects.
   1. Warranty Period: Lifetime of original installation.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Provide each product from one manufacturer.
C. Sustainable Construction Requirements:
   1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   2. Paints and coatings.
   3. Composite wood and agrifiber.

2.2 FLUSH WOOD DOORS

A. General:
   1. ANSI/WDMA I.S. 1A, Extra Heavy Duty.
   2. Adhesive: Type II.
   3. Core: Structural composite lumber, except when mineral core is required for fire rating.
   4. Thickness: 35 mm (1-3/8 inch) unless otherwise shown or specified.

B. Faces:
   1. ANSI/WDMA I.S. 1A.
   2. One species throughout project unless scheduled or otherwise shown.
   3. Transparent Finished Faces: Premium Grade. Plain sliced, Red Oak. A Grade face veneer.
   4. Match face veneers for doors for uniform effect of color and grain at joints.
   5. Door Edges: Same species as door face veneer.
   6. Painted Finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay.
   7. Factory sand doors for finishing.

C. Fire-Rated Wood Doors:
   1. Fire Resistance Rating:
      a. B Label: 1-1/2 hours.
      b. C Label: 3/4 hour.
   2. Provide 20-minute smoke-rated doors in smoke-rated barriers.
   3. Labels:
      a. Comply with NFPA 252, UL 10C, and labeled by qualified testing and inspection agency showing fire resistance rating.
         1) Metal labels with raised or incised markings.
   4. Performance Criteria for Stiles of Doors Utilizing Standard Mortise Leaf Hinges:
      a. Hinge Loading: WDMA TM 8. Average of 10 test samples for Extra Heavy Duty doors.
      b. Direct Screw Withdrawal: WDMA TM 10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.
      c. Cycle-Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested according to WDMA TM 7.
   5. Hardware Reinforcement:
      a. Provide fire rated doors with hardware reinforcement blocking.

b. Size of lock blocks as required to secure hardware specified.

c. Top, Bottom and Intermediate Rail Blocks: Minimum 125 mm (5 inches) by full core width.

d. Reinforcement blocking in compliance with labeling requirements. Mineral material similar to core is not acceptable.

6. Other Core Components: Manufacturer's standard as allowed by labeling requirements.

7. Glazed Vision Panel Frame: Steel approved for use in labeled doors.

8. Astragal: Steel type for pairs of doors.

2.3 FABRICATION

A. Factory machine interior wood doors to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.

1. Factory fit fire rated doors according to NFPA 80.

B. Rout doors for hardware using templates and location heights specified in Section 08 71 00, DOOR HARDWARE.

C. Factory fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness undercut where shown.

D. Clearances between Doors and Frames and Floors:

1. Fire Rated Doors: Comply with NFPA 80.

a. Doors with Automatic Bottom Seal: Maximum clearance 10 mm (3/8 inch) at threshold.

b. Other Door Bottoms: Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.

2. Door Jambs, Heads, and Meeting Stiles: Maximum 3 mm (1/8 inch).

E. Provide cutouts for glazed openings.

F. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.

G. Identify each door on top edge.

1. Mark with stamp, brand or other indelible mark, giving manufacturer’s name, door’s trade name, construction of door, date of manufacture and quality.

2. Mark door or provide separate certification including name of inspection organization.

3. Identify door manufacturing standard, including glue type.

4. Identify veneer and quality certification.

5. Identification of preservative treatment for stile and rail doors.

2.4 FINISHES

A. Field Finished Doors: Seal top and bottom edges of doors with two coats of catalyzed polyurethane or water resistant sealer.

B. Factory Transparent Finish:

1. Factory finish flush wood doors.

a. ANSI/WDMA I.S. 1A Section F-3 Finish System Descriptions for System 5, Conversion Varnish or System 7, Catalyzed Vinyl.

b. Use stain when required to produce finish specified in Section 09 06 00, SCHEDULE FOR FINISHES.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Verify door frames are properly anchored.

2. Verify door frames are plumb, square, in plane, and within tolerances for door installation.

B. Protect existing construction and completed work from damage.

C. Install astragal on active leaf of pair of smoke doors and one leaf of double egress smoke doors.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions.

1. Install fire rated doors according to NFPA 80.

2. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 PROTECTION

A. After installation, place shipping container over door and tape in place.

1. Do not apply tape to door faces and edges.

B. Provide protective covering over exposed hardware in addition to covering door.

C. Maintain covering in good condition until removal is directed by Contracting Officer's Representative.

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SECTION 08 34 53
SECURITY DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The extent of forced-entry resistant (FE) and ballistic resistant (BR) door assemblies required for the Project is indicated on Contract Drawings, and in Door/Frame/Hardware schedules, including construction, profiles, swing, sizes, hardware, accessories, devices, and locations.

1.2 RELATED WORK

A. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES: Doors and frames not designated for special security performances.

B. Section 08 14 00, INTERIOR WOOD DOORS: Doors and frames not designated for special security performances.

C. Section 08 71 00, DOOR HARDWARE: Door Hardware.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

A153/A153M-16a.....Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A240/A240M-20.....Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and General Applications

A653/A653M-20.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A1008/A1008M-20.....Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

A1011/A1011M-18a.....Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

D1044-19.....Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion.

C. American National Standards Institute (ANSI):

ANSI A156.115 (2014) ..... Hardware Preparation in Steel Doors and Steel Frames

ANSI A156.115W (2006) ..... Hardware Preparation in Wood Doors with Wood or Steel Frames

ANSI/SDI A250.8 (2014) ..... Specifications for Standard Steel Doors and Frames

ANSI/SDI A250.11 (2012) ..... Recommended Erection Instructions for Steel Frames.

D. American Welding Society (AWS):

D1.1/D1.1M (2010) ..... Structural Welding Code - Steel

E. National Fire Protection Association (NFPA):

NFPA 80 (2013)..... Standard for Fire Doors and Other Opening Protectives

NFPA 252(2013) ..... Standard Methods of Fire Tests of Door Assemblies

F. Society for Protective Coatings (SSPC):

SSPC-SP 2 - 2004..... Hand Tool Cleaning

SSPC-SP 3 - 2004..... Power Tool Cleaning

G. Underwriters Laboratories, Inc. (UL):

UL 752-2005..... Bullet Resisting Equipment

H. United States Department of State Bureau of Diplomatic Security (DS):

SD-STD-01.01-1993(R2004)..... Certification Standard for Forced Entry and Ballistic Resistance of Structural Systems

1.4 PERFORMANCE REQUIREMENTS

A. General: Fabricate and install FE/BR door assemblies to achieve indicated levels of resistance. Extend resistance to include anchorages, interfaces with adjoining substrates, and hardware. Security attacks shall be unable to penetrate through closed/locked security door assemblies in manner described; it is recognized that such attacks may damage units beyond repair and reuse, requiring replacement of work by Government:

1. Fire-rated assemblies: Where indicated for fire resistance, provide flush steel doors-and-frame units; comply with NFPA 80. Provide units that have been tested by recognized testing agency in accordance with NFPA No. 252
2. Forced-Entry (FE) resistant assemblies: Where door assembly is shown or scheduled as FE, provide door manufacturer's material and fabrication for panels, inserts, hardware, devices, and framing of units. Provide rated units where shown or scheduled:

3. No FE resistance rating.
4. Ballistic Resistant (BR) assemblies: Where door assembly is shown or scheduled as BR, provide door manufacturer's materials and fabrication for panel, inserts, and framing of unit. Provide rated units where shown or scheduled. No BR resistance rating

1.5 SUBMITTALS

A. General: For each security door assembly, submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

1. Product data for each element of work, whether purchased from other manufacturers or provided as door Fabricator's standard production. Include data substantiating that products comply with requirements of these specifications.
2. Manufacturer's standard color chart.
3. Certificates: Letter from manufacturer indicating the products have been certified to meet the specified ratings.
4. Shop drawings showing each dimensioned details of each door assembly, including performance rating, swing, hardware set, and adjacent construction. Provide drawings on B-size 11 in x 17 inch (300 mm x 430 mm) sheets. Show typical door exterior elevations at not less than ¼ inch = 1 foot (1:50) scale. After final modifications and corrections have been incorporated into the drawings, submit drawings as AutoCAD files with DWG extension. Show the following:
    a. Unit information:
        1) Model Number.
        2) Ballistic resistant rating.
        3) Marks (window no.).
        4) Door/frame finish.
        5) Door type.
    b. Elevation Drawings:
        1) Rough opening.
        2) Door opening.
        3) Frame opening.
        4) Vision opening.
        5) Finished floor.
        6) Sill condition.

7) Undercut for carpet.
8) Weather-stripping.
9) Reference numbers for primer and finish paint, including number of coats applies.
10) Door class rating: rated or non-rated.
11) Door and frame gauge thickness.

c. Plan drawings:
1) Relate to elevation on drawing.
2) Identify “Attack” and “Protected” sides.
3) Identify door swing (i.e., RH, LH, RHRB, LHRB).
4) Provide key on drawings.
5) Indicate room space numbers taken from Contract Drawings.

d. Details: Show section at not less than ¾ inch = 1 ft (1:20) scale of members indicating construction, size, and thickness of components, frame profile, location of conduit entry, threshold configuration, vision panel together with connections, fastenings, and means of separating dissimilar metals.

e. Breakdown of Product Line Items:
1) If Manufacturer produces one contract line item as several parts (door with transom and sidelights), they shall breakout items on drawings. Each item shall be a subdivision of that product line item number.
2) Installation instructions shall cite all anchorage components, including complete description of expansion anchor as well as installation criteria such as torque requirements, minimum embedment, and minimum edge distance, and shall include alert to installers to avoid cutting of rebar during concrete anchor installation.

1.6 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: For compliance with non-security performance requirements (such as fire ratings, resistance to deterioration from moisture, accessibility to persons with disabilities, or sound attenuation) on security door assemblies of this Section, use only those testing laboratories which have successfully demonstrated to Project Manager that they have experience and capabilities needed to satisfactorily conduct required tests.

B. Provide products that have been certified by Bureau of Diplomatic Security (DS) in accordance with DS/PSD SD-STD-01.01.

1.7 IDENTIFICATION SYSTEMS

A. Identify each assembly to provide VA with ready reference to original manufacturer to facilitate reorders, replacement parts, service, resolution of complaints, and inventory. The label shall be typically embossed/printed metal plate or metallic foil with adhesive backing for permanent identification. Locate label so that it is readily visible and convenient for identification by Project Manager after installation of assembly. The label shall be approximately 1½ inch x 3 inch (40 x 75 mm) and shall cite:

1. Manufacturer's name/city/state.
2. Contract number.
3. Month/Year of manufacture.
4. Mark number and Ballistic resistant rating.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver each assembly project site with fabrication, finishing, and assembly of primary panels, inserts, and frames completed and prepared for installation and connection with security systems. Disassemble hardware for shipping only to extent hardware interferes with shipping.

B. Refer to Division One for shipping requirements.

C. Provide removable spreader bar between jambs during fabrication, delivery, and installation and to include mullions of each frame assembly, except where integral threshold is required and serves same purpose. Do not mar finishes of assembly with installation or removal of spreader bars.

D. Provide protection of pre-finished units, such as pre-finished with baked enamel or stainless steel, using self-adhesive paper.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Certified units: provide units, including frames and sub-frames which are produced by manufacturer who has previously produced, within last 10 years, units of similar security attack resistance of equivalent size and resistance ratings.

2.2 MATERIALS, GENERAL

A. Hot-Rolled Steel Sheets and Strips: ASTM A1011, commercial quality, pickled and oiled, except as otherwise indicated.

B. Cold-Rolled Steel Sheets: ASTM A1008, commercial quality, except as otherwise indicated.

C. Galvanized Steel Sheets: ASTM A653 with G90 zinc coating, mill phosphatized; commercial quality, except as otherwise indicated.

D. Stainless Steel Sheets: AISI Type 302/304, complying with ASTM A240; commercial quality, No. 4 directional polish.

E. Supports and Anchors: Fabricate to endure required performances, but of not less than 1/16 inch (1.5 mm) sheet steel. For exterior wall assemblies, hot-dip zinc coat support/anchor units after fabrication in compliance with ASTM A 153, Class B.

F. Inserts, Bolts, Fasteners: Standard units of strengths required to endure performances; hot-dip zinc coated where used in exterior wall assemblies in compliance with ASTM A 153, Class C/D.

G. Vision Lights General: Fabricate vision lights of sizes shown and scheduled with same performance capabilities as specified/shown for door assembly where installed. Where applicable, achieve performances and combined performances through lamination of transparent sheets, films, and screens of standard manufactured/tested products. Comply with applicable provisions of Division 8, Section 08 80 00, GLAZING.

1. Forced-Entry (FE) Resistance: Where assembly is indicated for forced-entry resistance rating (FE), provide light of size shown or scheduled in accordance with certification.
2. Ballistic Resistance (BR): Where assembly is indicated for ballistic-resistance rating (BR), provide light of size shown or scheduled in accordance with certification.
3. Vision light faces general: Except as otherwise shown, where forced-entry or ballistic resistance is required, provide face of light exposed on exterior (to the “attack”) as glass surface, and where unit is of laminated construction, provide face exposed on interior (“safe”) as polycarbonate surface. Provide exposed polycarbonate surfaces to include an abrasion-resistant coating for 3 percent maximum haze increase for 100 revolutions on 500g Taber abraser, ASTM D1044.

2.3 HARDWARE

A. General: Provide special units of door hardware to achieve performances, and as shown and scheduled. Standard units for each security door assembly are specified to be furnished as work of Section 08 71 00, DOOR HARDWARE; see Project “Finish Hardware Schedule” and “Data Sheets,” and provisions of this Section, as well as notes on door-and-frame schedule.

2.4 FABRICATION AND ASSEMBLY

A. General: Fabricate, test, and preassemble security door assemblies with hardware at factory; disassemble hardware only to extent necessary for handling, packaging, shipment, and

installation at Project. Fabricate metal work to comply with performance requirements. Fabrications shall be rigid, neat, and free from warp/buckle/similar defects, with eased edges and continuously-welded joints, ground where exposed, to produce smooth, flush, invisible joints. Weld in accordance with AWS D1.1, Structural Welding Code for Steel:

1. Prepare panels and frames of each assembly to receive hardware, devices, and accessory units as shown and scheduled. Reinforce work for hardware and devices, and cut work for mortised or concealed units; comply with ANSI A156.115, working from templates supplied by unit manufacturers and suppliers:
    a. Locate hardware, devices, and accessories as required by Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 71 00, DOOR HARDWARE.
    b. Locate hardware, devices, and accessories as shown and scheduled (including on approved shop drawings) or, if not otherwise indicated: 1) in accordance with ANSI A156.115 and A156.115W Recommended Locations for Builder's Hardware or, 2) in accordance with security device manufacturer's recommendation for optimum responses, but 3) in any case, as required to achieve required assembly performances.
    c. Except where assembly is equipped with door-seal stripping at jambs and head, provide neoprene door silencers on stops; three at strike jamb for single door, and four at head for double door.
    d. Except as otherwise indicated, pre-fabricate and preassemble security door assemblies to include full extent of required conduit-protected electrical/electronic power-and-control wiring placed and supported to avoid conflicts with other elements and subsequent drilling/cutting-in of work during installation of units. Provide access ports as required to support 1 inch (25 mm) conduit.
    e. Clearances: Not more than 1/8 inch (3 mm) at jambs and heads, except not more than 1/4 inch (6 mm) between fire-rated pair of doors. Nor more than 1/4 inch (6 mm) at bottom. Undercut for carpets are not permitted where doors are used in corridors. Fabricate frames with horizontally slotted bolt holes.
2. Provide removable glazing stops and similar moldings on interior or “safe” side of assemblies. Glazing shall be removable without removing door from frame.

3. Shop Painting: Provide base-coat, factory-applied painting of ferrous metal elements of assemblies excluding other specified exposed-finish surfaces of stainless steel, aluminum, bronze, and similar metals not intended for painting.
    a. Clean steel and zinc-coated steel surfaces of mill scale, rust, oil, grease, dirt and other substances, immediately before finish application.
    b. Apply pretreatment of cold phosphate solution (SSPC-SP 2) or basic zinc chromate/vinyl-butyl solution (SSPC-SP 3).
    c. Apply paint coat specified for shop application, and bake on within time limits recommended by manufacturer of pretreatment. Apply in a uniform, smooth coat to result in dry film thickness of not less than 0.002 inch (0.05 mm).
4. Vision panels:
    a. The transparencies shall be enclosed and cushioned within core of door for continuous perimeter bite of not less than ¾ inch (20 mm) on each side and 1/4 inch (6 mm) cushion clearance to fixed metal stop on glazing edges. Glazing shall be installed by manufacturer with no raw metal edges evident or in contact with glass in door vision openings. Vision opening edges shall be cushioned and trimmed neatly to provide acceptable appearance.
    b. If external frames are used to either side or to both faces of door, frame(s) shall not exceed 1-9/16 inch (40 mm) in width and shall be configured internally to cushion all perimeter edges and faces of glazing and provide minimum bite of 3/4 inch (20 mm) and 1/4 inch (6 mm) cushion clearance to fixed metal stop on glazing edges. Frame shall not produce pinch point with hardware. All external bolts to attach frame shall be flush mounted. Alternatively, protruding bolt heads shall be covered with additional trim frame and flush mounted screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install security door assemblies in accordance with approved shop drawings, manufacturer's data and instructions, and requirements of these specifications. Install as required to achieve specified performances, and to comply with recommendations of related industry association or testing agency sponsoring standards for required non-security performances. Install door assemblies plumb and level:

1. Install assemblies in compliance with recommendations and instructions of ANSI A250.8 and ANSI A250.11.
2. At fire-rated door openings, comply with NFPA Standard No. 80.
3. Properly hang and align FE/BR doors so that pull open exertion does not exceed 12 lbs (5.4 kg.).
4. Installer shall not grind any portion of door, frame or locking device strikes.
5. Locking device strikes shall engage strike plate without binding.

B. Anchorage: The door manufacturer shall provide anchors appropriate for substrate to which door frame is to be fastened. Structural frames shall have pre-drilled bolt hole patterns not to exceed 12 inches (300 mm) on center. The manufacturer shall verify substrates involved, and supply any special fastening tools (e.g., special drill or bit) required by anchoring system. The anchor shall be acceptable for shock/short duration loading, and have potential for removal during life of building. The anchor shall also meet the following requirements:

1. Anchor diameter: 3/8 inch (10 mm) minimum.
2. Embedment and edge distances shall be as indicated on Contract Drawings and as appropriate for anchor and substrate, but not less than the following:
    a. Embedment in concrete: 3 1/2 inches (90 mm).
    b. Embedment in solid masonry: 6 inches (150 mm).
    c. Edge distance: 3 inches (75 mm).
3. The minimum anchor strengths shall be:
    a. Yield Strength: 135,000 psi (900 MPa)
    b. Tensile Strength: 186,000 psi (1240 MPa)
4. Avoid cutting of rebar during concrete anchor installation. Shims provided for rough opening (RO) frame clearance should not exceed1/4 inch (6 mm). Cap plugs used in frame shall match frame finish.

3.2 ADJUST AND CLEAN

A. General: Upon request of Project Manager, remove protective coverings and clean exposed surfaces. Repair damaged elements, restore abraded surfaces, touch-up base-coat paint finish with air-drying primer, and remove imperfections from exposed natural metal finishes.

B. Check and readjust hardware, devices, and accessories with door-to-frame-and-sill/threshold clearances set for proper operation of locks, door seals, and other operational units. Do not remove permanently applied performance labels.

C. Comply with "Door Hardware" section requirements for protection and handling of keys and locking devices, and associated information.

D. Exercise extreme care in the cleaning of exposed surfaces of polycarbonate; comply with manufacturer's directions.

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SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 14 00, WOOD DOORS and Section 08 11 13, HOLLOW METAL DOORS AND FRAMES

C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.

D. Painting: Section 09 91 00, PAINTING.

E. Card Readers: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS.

F. Electrical: Division 26, ELECTRICAL.

G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 GENERAL

A. All hardware shall comply with ABAAS, (Architectural Barriers Act Accessibility Standard) unless specified otherwise.

B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).

C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.

D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.

E. The following items shall be of the same manufacturer, except as otherwise specified:

1. Mortise locksets.
2. Hinges for hollow metal and wood doors.
3. Surface applied overhead door closers.

4. Exit devices.
5. Floor closers.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
   1. Locks, latchsets, and panic hardware: 5 years.
   2. Door closers and continuous hinges: 10 years.

1.5 MAINTENANCE MANUALS

A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: AHC certified hardware consultant to prepare and submit hardware schedule in the following form:

HW Item	QTY	Size	Ref Publication Type No.	Fin	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if FR and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:
   1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
   2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

E. Record of opening force measurement for all doors equipped with closers

1.7 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

1.8 PREINSTALLATION MEETING

A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer’s Representative. Review the following:

1. Inspection of door hardware.
2. Job and surface readiness.
3. Coordination with other work.
4. Protection of hardware surfaces.
5. Substrate surface protection.
6. Installation.
7. Adjusting.
8. Repair.
9. Field quality control.
10. Cleaning.

1.9 INSTRUCTIONS

A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by

symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.

B. Keying: All cylinders shall be keyed into existing Grand Master Key System. Provide removable Small Format Mortise Lock core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 6 pin type. Keying information shall be furnished at a later date by the COR.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.

B. ASTM International(ASTM):

F883-13 ..... Padlocks

E2180-18 ..... Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials

C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

A156.1-06..... Butts and Hinges

A156.2-03..... Bored and Pre-assembled Locks and Latches

A156.3-08..... Exit Devices, Coordinators, and Auto Flush Bolts

A156.4-08..... Door Controls (Closers)

A156.5-14..... Cylinders and Input Devices for Locks.

A156.6-05..... Architectural Door Trim

A156.8-05..... Door Controls-Overhead Stops and Holders

A156.11-14..... Cabinet Locks

A156.12-05..... Interconnected Locks and Latches

A156.13-05..... Mortise Locks and Latches Series 1000

A156.14-07..... Sliding and Folding Door Hardware

A156.15-06..... Release Devices-Closer Holder, Electromagnetic and Electromechanical

A156.16-08..... Auxiliary Hardware

A156.17-04.....Self-Closing Hinges and Pivots

A156.18-06.....Materials and Finishes

A156.20-06.....Strap and Tee Hinges, and Hasps

A156.21-09.....Thresholds

A156.22-05.....Door Gasketing and Edge Seal Systems

A156.23-04.....Electromagnetic Locks

A156.24-03.....Delayed Egress Locking Systems

A156.25-07.....Electrified Locking Devices

A156.26-06.....Continuous Hinges

A156.28-07.....Master Keying Systems

A156.29-07.....Exit Locks and Alarms

A156.30-03.....High Security Cylinders

A156.31-07.....Electric Strikes and Frame Mounted Actuators

A156.36-10.....Auxiliary Locks

A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):

80-10 .....Fire Doors and Other Opening Protectives

101-09 .....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):

Building Materials Directory (2008)

F. Architectural Barriers Act Accessibility Standards (ABAAS)

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112/A5112 for doors 3 feet wide or less and Type A2111/A5111 for doors over 3 feet wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.

2. Interior Doors: Type A8112/A5112 for doors 3 feet wide or less and Type A8111/A5111 for doors over 3 feet wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors up to 4 feet high: 2 hinges.
2. Doors 4 feet to 7 feet 5 inches high: 3 hinges minimum.
3. Doors greater than 7 feet 5 inches high: 4 hinges.
4. Doors up to 3 feet wide, standard weight: -1/2 inches x 4-1/2 inches hinges.
5. Doors over 3 feet to 3 feet 6 inches wide, standard weight: 5 inches x 4-1/2 inches.
6. Doors over 3 feet 6 inches to 4 feet, heavy weight: 5 inches x 4-1/2 inches.
7. Provide heavy-weight hinges where specified.
8. At doors weighing 150 pounds or more, furnish 5 inch high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.2 CONTINUOUS HINGES – NOT USED

2.3 DOOR CLOSING DEVICES

A. Closing devices shall be products of one manufacturer.

2.4 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:

1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
2. Where specified, closer shall have hold-open feature.
3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
4. Material of closer body shall be forged or cast.
5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
7. Closers shall have full size metal cover; plastic covers will not be accepted.

8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½” minimum piston diameter.

2.5 FLOOR CLOSERS AND FLOOR PIVOT SETS – NOT USED

2.6 DOOR STOPS

A. Conform to ANSI A156.16.

B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use expansion shields for mounting door stops.

C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.

D. Provide floor stops (Type L02141 or L02161) in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.

E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.

F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 3-inch core-drilled hole and filled with quick-setting cement.

G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.

H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.

I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.

J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.

K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.

L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.7 OVERHEAD DOOR STOPS AND HOLDERS – NOT USED

2.8 FLOOR DOOR HOLDERS – NOT USED

2.9 LOCKS AND LATCHES

A. Conform to ANSI A156.2. Locks and latches for doors 1-3/4 inch thick or over shall have beveled fronts. Lock cylinders shall have not less than six pins. Cylinders for all locksets shall be removable core type (Small Format Mortise Locks). Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 3/4 inch throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.

B. In addition to above requirements, locks and latches shall comply with following requirements:

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) lever design. No substitute lever material shall be accepted.

All locks and latchsets shall be furnished with 4-7/8-inch curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 7/8-inch lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.

2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 4-7/8-inch curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 7/8-inch lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)
3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.36.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.

2.10 PUSH-BUTTON COMBINATION LOCKS – NOT USED

2.11 ELECTROMAGNETIC LOCKS

A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
   1. Type: Full exterior or full interior, as required by application indicated.
   2. Strength Ranking: 1500 pound force.
   3. Inductive Kickback Peak Voltage: Not more than 53 V.
   4. Residual Magnetism: Not more than 4 pound force to separate door from magnet.

B. Delayed-Egress Locks: BHMA A156.24. Listed under Category G in BHMA's "Certified Product Directory".

1. Means of Egress Doors: Lock releases within 15 seconds after applying a force not more than 15 pound force for not more than 3 seconds, as required by NFPA 101.
2. Security Grade: Activated from secure side of door by initiating device.
3. Movement Grade: Activated by door movement as initiating device.
4. The lock housing shall not project more than 4-inches from the underside of the frame head stop.

2.12 ELECTRIC STRIKES

A. ANSI/ BHMA A156.31 Grade 1.

B. General: Use fail-secure electric strikes at fire-rated doors.

2.13 KEYS

A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

LOCKS/KEYS	QUANTITY
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

B. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

2.14 KEY CABINET – NOT USED

2.15 ARMOR PLATES, KICK PLATES, MOP PLATES

A. Conform to ANSI Standard A156.6.

B. Provide protective plates as specified below:

1. Kick plates, mop plates and armor plates of metal, Type J100 series.
2. Provide kick plates and mop plates where specified. Kick plates shall be 10 inches or 12 inches high. Mop plates shall be 6 inches high. Both kick and mop plates shall be minimum 0.050 inches thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 1-1/2 inches less than width of door, except pairs of metal doors which shall have plates 1 inch less than width of each door. Extend all other kick and mop plates to within 1/4 inch of each edge of doors. Kick and mop

plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.

3. Kick plates and/or mop plates are not required on following door sides:
   a. Armor plate side of doors;
   b. Exterior side of exterior doors;
   c. Closet side of closet doors;
   d. Both sides of aluminum entrance doors.
4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 35 inches high and 1-1/2 inches less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 1 inch less than width of each door. Where top of intermediate rail of door is less than 35 inches from door bottom, extend armor plates to within 1/2 inch of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 1/2 inch of panic bolt push bar.
5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 10 inches high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.16 EXIT DEVICES – NOT USED

2.17 FLUSH BOLTS (LEVER EXTENSION) – NOT USED

2.18 FLUSH BOLTS (AUTOMATIC)

A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than -1/2 by 3-1/2 inches.

B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.19 LIGATURE RESISTANT DOOR ALARM – NOT USED

2.20 DOOR PULLS WITH PLATES – NOT USED

2.21 PUSH PLATES – NOT USED

2.22 COMBINATION PUSH AND PULL PLATES – NOT USED

2.23 COORDINATORS

A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

2.24 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

B. For thresholds at elevators entrances see other sections of specifications.

C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

D. Provide with miter returns where threshold extends more than 0.5 inch beyond face of frame.

2.25 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET FOR LIGHT PROOF OR SOUND CONTROL DOORS

A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

2.26 WEATHERSTRIPS (FOR EXTERIOR DOORS) – NOT USED

2.27 MISCELLANEOUS HARDWARE

A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E07213, conforming to ANSI A156.11. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.

B. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

2.28 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES – NOT USED

2.29 THERMOSTATIC TEMPERATURE CONTROL VALVE CABINETS – NOT USED

2.30 HINGED WIRE GUARDS (FOR WINDOWS, DOORS AND TRANSOMS) AND WIRE PARTITION DOORS – NOT USED

2.31 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.

B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:

1. Hinges --interior doors: 652 or 630.
2. Pivots: Match door trim.
3. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
4. Thresholds: Mill finish aluminum.
5. Cover plates for floor hinges and pivots: 630.
6. Other primed steel hardware: 600.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.

E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.

F. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

2.32 BASE METALS

A. Apply specified U.S. Standard finishes on different base metals as following:

FINISH	BASE METAL
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to VA COR for approval.

B. Hardware Heights from Finished Floor:

1. Exit devices centerline of strike (where applicable) 40-5/16 inches.
2. Locksets and latch sets centerline of strike 40-5/16 inches.
3. Deadlocks centerline of strike 48 inches.
4. Hospital arm pull 46 inches to centerline of bottom supporting bracket.
5. Centerline of door pulls to be 40 inches.
6. Push plates and push-pull shall be 50 inches to top of plate.
7. Push-pull latch to be 40-5/16 inches to centerline of strike.
8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors Where closers

are mounted on doors they shall be mounted with hex nuts and bolts; foot shall be fastened to frame with machine screws. Door opening force shall not exceed 5 pounds maximum in accordance with ABAAS. Measure and adjust opening force for all doors equipped with closers.

B. Hinge Size Requirements:

DOOR THICKNESS	DOOR WIDTH	HINGE HEIGHT
1-3/4 inch	3 feet and less	4-1/2 inches
1-3/4 inch	Over 3 feet but not more than 4 feet	5 inches
1-3/8 inch (hollow core wood doors)	Not over 4 feet	4-1/2 inches

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

DOOR DESCRIPTION	NUMBER BUTTS
Doors over 5 ft high and not over 7 ft 6 in high	3 butts
Doors over 7 feet 6 inches high	4 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the COR for his records.) Installation of locks which do not meet specified

keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 FINAL INSPECTION

A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:

1. Re-adjust hardware.
2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
3. Identify items that have deteriorated or failed.
4. Submit written report identifying problems.

3.4 DEMONSTRATION

A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

3.5 HARDWARE SETS

A. Following sets of hardware correspond to hardware symbols shown on drawings. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.

B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

C. ELECTRIC AND SECURITY HARDWARE ABBREVIATIONS LEGEND:

1. AC = Access Control Device (Card reader, biometric reader, keypad, etc.)
2. DPS = Door Position Switch
3. EL = Electric Lock or Electric Lever Exit Device
4. REX = Request-to-exit Switch in Latching Device inside Trim

D. INTERIOR SINGLE DOORS

HW-3E

Each Door to Have:	NON-RATED
Hinges	QUANTITY & TYPE AS REQUIRED
1 Office Lock	F04
1 Floor Stop	L02121 x 3 FASTENERS

1 Set Self-Adhesive Seals	R0Y154
1 Coat Hook	L03121

OMIT COAT HOOK WHERE GLASS LITE PREVENTS INSTALLATION.

E. INTERIOR SINGLE SECURITY DOORS

HW-SH-3

Each [AC, EL, REX, DPS] Door to Have: RATED/NON-RATED

Hinges	QUANTITY & TYPE AS REQUIRED
1 Transfer Hinge	4-WIRE TYPE AS REQUIRED
1 Electrified Lock	F07 (E01-REX, E06) 24VDC
1 Power Supply	Regulated, Filtered, 24VDC, Amperage as required
1 Closer	C02011/C02021
1 Floor Stop	L02121 x 3 FASTENERS
1 Threshold	J32300 x width 2-1/4 inches
1 Auto Door Bottom	R0Y346 – HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154
1 Alarm Contact	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

CARD READER BY DIVISION 28.

F. INTERIOR PAIRS OF SECURITY DOORS

HW-SH-9

Each [AC, EL, REX, DPS] Pair to Have: RATED

Hinges	QUANTITY & TYPE AS REQUIRED
1 Transfer Hinge	4-WIRE TYPE AS REQUIRED
1 Set Auto Flush Bolts	TYPE 25
1 Dust Proof Strike	L04021
1 Electrified Lock	F07 (E01-REX, E06) 24VDC
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Coordinator	TYPE 21A

1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 x THRU-BOLTS
2 Closers	C02011/C02021
2 Kick Plates	J102 (@ STORAGE ROOMS ONLY)
2 Floor Stops	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154
2 Alarm Contacts	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

CARD READER BY DIVISION 28.

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SECTION 09 05 16
SUBSURFACE PREPARATION FOR FLOOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies subsurface preparation requirements for areas to

B. receive the installation of applied and resinous flooring. This section includes removal of existing floor coverings, testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, and floor leveling and repair as required.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS.

B. Section 09 65 19, RESILIENT TILE FLOORING

C. Section 09 66 00, ANTI-STATIC CONCRETE SEALER

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.

B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer

C. Product Data:

1. Moisture remediation system
2. Underlayment Primer
3. Cementitious Self-Leveling Underlayment
4. Cementitious Trowel-Applied Underlayment (Not suitable for resinous floor finishes)

D. Test Data:

1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer’s technical representative.

1.4 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

B. ASTM International(ASTM):

D638-14(2014) .....Standard Test Method for Tensile Properties of Plastics

D4259-18(2019) .....Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application.

C109/C109M-20b(2020) .....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens

7234-19(2020).....Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

E96/E96M-16(2016).....Standard Test Methods for Water Vapor Transmission of Materials

F710-1e1(2020).....Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

F1869-16a .....Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-19a(2020).....Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

C348-20(2020) .....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

C191-19(2020) .....Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle

PART 2 - PRODUCTS

2.1 MOISTURE REMEDIATION COATING

A. System Descriptions:

1. High-solids, epoxy system designed to suppress excess moisture in concrete prior to an overlayment. For use under resinous products, VCT, tile and carpet where issues caused by moisture vapor are a concern.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.

C. System Components: Verify specific requirements as systems vary by manufacturer. Verify build up layers and installation method. Verify compatibility with substrate. Use manufacturer's standard components, compatible with each other and as follows:

1. Liquid applied coating:

a. Resin: epoxy.
b. Formulation Description: Multiple component high solids.
c. Application: Per manufacturer's written installation requirements.
d. Thickness: minimum 10 mils

D. Material Vapor Permeance: Application shall achieve a permeance rating of less than 0.1 perm in accordance with ASTM E96/E96M.

E. Maximum RH requirement: 100% testing in accordance with ASTM F2170.

Property	Test	Value
Tensile Strength	ASTM D638	4,400 psi
Volatile Organic Compound Limits (V.O.C.)	SCAMD Rule 1113 (Amended 02/05/2016)	25 grams per liter
Permeance	ASTM E96	0.1 perms
Tensile Modulus	ASTM D638	$1.9X10^5$ psi
Percent Elongation	ASTM D638	12%
Cure Rate	Per manufacture's Data	4 hours Tack free with 24hr recoat window
Bond Strength	ASTM D7234	100% bond to concrete failure

2.2 CEMENTITIOUS SELF-LEVELING UNDERLAYMENT

A. System Descriptions:

1. High performance self-leveling underlayment re-surfacer. Single component, self-leveling, cementitious material designed for easy application as an underlayment for all types of flooring materials. It is used for substrate repair and leveling.

B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up. Gypsum-based products are unacceptable.

C. System Characteristics:

1. Wearing Surface: smooth

2. Thickness: Per architectural drawings, ranging from feathered edge to 1”, per application. Applications greater than 1” require additional 3/8” aggregate to mix or as recommended by manufacturer.

D. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

E. Compressive Strength: Minimum 4100 psi in 28 days in accordance with ASTM C109/C109M.

F. Flexural Strength: Minimum 1000 psi in 28 days in accordance with ASTM C348

G. Dry Time: Underlayment shall receive the application of moisture insensitive tile in 6 hours, floor coverings in 16 hours, and resinous flooring in 3-7 days.

H. Primer: compatible and as recommended by manufacturer for use over intended substrate

I. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer:
   a. Resin: copolymer
   b. Formulation Description: single component ready to use.
   c. Application Method: Squeegee and medium nap roller.
   d. All puddles shall be removed, and material shall be allowed to dry, 1-2 hours at 70F/21C.
   e. Number of Coats: (1) one.
2. Grout Resurfacing Base:
   a. Formulation Description: Single component, cementitious self-leveling high-early and high-ultimate strength grout.
   b. Application Method: colloidal mix pump, cam rake, spike roll.
      1) Thickness of Coats: Per architectural scope, 1” lifts.
      2) Number of Coats: More than one if needed.
   c. Aggregates: for applications greater than 1inch, require additional 3/8” aggregate to mix.

Property	Test	Value
Compressive Strength	ASTM C109/C109M	2,200 psi @ 24 hrs 3,000 psi @ 7 days
Initial set time Final Set time	ASTM C191	30-45 min. 1 to 1.5 hours

J. Property	Test	Value
Bond Strength	ASTM D7234	100% bond to concrete failure

2.3 CEMENTITIOUS TROWEL-APPLIED UNDERLAYMENT (NOT SUITABLE FOR RESINOUS FLOOR FINISHES)

A. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.

B. Compressive Strength: Minimum 4000 psi in 28 days

C. Trowel-applied underlayment shall not contain silica quartz (sand).

D. Dry Time: Underlayment shall receive the application of floor covering in 15-20 minutes.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.

C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

3.2 SURFACE PREPARATION

A. Existing concrete slabs with existing floor coverings:

1. Conduct visual observation of existing floor covering for adhesion, water damage, alkaline deposits, and other defects.
2. Remove existing floor covering and adhesives. Comply with local, state and federal regulations and the RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to the floor covering being removed.

B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.

C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.

D. Prepare concrete substrates per ASTM D4259 as follows:

1. Dry abrasive blasting.
2. Wet abrasive blasting.
3. Vacuum-assisted abrasive blasting.
4. Centrifugal-shot abrasive blasting.
5. Comply with manufacturer's written instructions.

E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.

F. Verify that concrete substrates are dry.

G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of per flooring manufactures formal and project specific written recommendation.

H. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity per flooring manufacture’s formal and project specific written recommendation.

I. Provide a written report showing test placement and results.

J. Prepare joints in accordance with Section 07 92 00, JOINT SEALANTS and material manufacturer’s instructions.

K. Alkalinity: Measure surface pH in accordance with procedures provided in ASTM F710 or as outlined by qualified testing agency or flooring manufacturer’s technical representative.

L. Tolerances: Subsurface shall meet the flatness and levelness tolerance specified on drawings or recommended by the floor finish manufacturer. Tolerance shall also not to exceed 1/4” deviation in 10’. As required, install underlayment to achieve required tolerance.

M. Other Subsurface: For all other subsurface conditions, such as wood or metal, contact the floor finish or underlayment manufacturer, as appropriate, for proper preparation practices.

3.3 MOISTURE REMEDIATION COATING

A. Where results of relative humidity testing (ASTM F2170) exceed the requirements of the specified flooring manufacturer, apply remedial coating as specified to correct excessive moisture condition.

B. Prior to remedial floor coating installation mechanically prepare the concrete surface to provide a concrete surface profile in accordance with ASTM D4259.

C. Mix and apply moisture remediation coating in accordance with manufacturer’s instructions.

3.4 CEMENTITOUS UNDERLAYMENT

A. Install cementitious self-leveling underlayment as required to correct surface defects, floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, address non-moving cracks or joints, or meet elevation requirements detailed on drawings.

B. Mix and apply in accordance with manufacturer's instructions.

3.5 PROTECTION

A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, tempered hardwood, or other suitable protection course

3.6 FIELD QUALITY CONTROL

A. Where specified, field sampling of products shall be conducted by a qualified, independent testing facility.

- - - E N D - - -

SECTION 09 06 00
SCHEDULE FOR FINISHES

SECTION 09 06 00-SCHEDULE FOR FINISHES

VAMC: White River Junction

Location: White River Junction, VT

Project no. and Name: 405-22-700 – EHRM Infrastructure Upgrades

Submission: 95% CD1

Date: 7/21/25

SECTION 09 06 00
SCHEDULE FOR FINISHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS

A. Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS

A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES-provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.

B. MASTER PAINTING INSTITUTE: (MPI)

6/1/2019 .....Architectural Painting Specification Manual

PART 2 - PRODUCTS

2.1 DIGITAL COLOR PHOTOS

A. Size 24 x 35 mm.

B. Labeled for:

1. Building name and Number.

2. Room Name and Number.

2.2 DIVISION 03 – CONCRETE

A. SECTION 03 30 00, CAST IN PLACE CONCRETE

Surface	Finish Description
Exposed Concrete Floor	Anti-Static Coating

2.3 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

1. Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	
Component	Color of Paint Type and Gloss
Door	Match Existing
Frame	Match Existing
Window frame	Match Existing

B. SECTION 08 14 00, INTERIOR WOOD DOORS

Component	Finish/Color
Doors	Match Existing
Frames	Match Existing

C. SECTION 09 65 19, RESILIENT TILE FLOORING

Finish Code	Size	Material/Component	Manufacturer	Mfg Name/No.
VCT	12''x12''	VCT	VPI	Glacier/09

D. SECTION 09 65 13, RESILIENT BASE AND ACCESSORIES

Finish Code	Item	Height	Manufacturer	Mfg Name/No.
RB-01	Rubber Base (RB)	4''	Armstrong	Parchment / 48PR

E. SECTION 09 91 00, PAINTING

1. MPI Gloss and Sheen Standards

		Gloss @60	**Sheen @85**
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-“a velvet-like” finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional “egg-shell like” finish	10-25 units, and	10-35 units
Gloss Level 4	a “satin-like” finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	

Gloss level 7 a high gloss more than 85 units

2. Paint code	Gloss	Manufacturer	Mfg. Color Name/No.
P-01	Match Existing	Match Existing	Color to Match Existing
P-02	Level 3	Sherwin Williams	SW 7005
P-03	Flat	Flame Off	White
AST			As selected by VA

F. SECTION 10 26 00, WALL AND DOOR PROTECTION

Item	Material	Manufacturer	Mfg. Color Name/No.
Corner Guards	PVC	INPRO	G2130/0154 Clamshell
Wall Guard	Rigid Vinyl Sheet	INPRO	Dove Gray 0106
Door Frame Protection	PVC	INPRO	G21700/0154 Clamshell

G. SECTION 10 14 00, INTERIOR SIGNAGE

Sign Type	Component	Manufacturer	Mfg. Color Name/No.
ROOM NUMBER SIGN	Face	Wilsonart	499-38 FLAX LINEN
ROOM NUMBER SIGN	Backer	Wilsonart	7929-38 Huntington Maple
ROOM NUMBER SIGN	Metal Accent	-	Bronze
ROOM NUMBER SIGN	Text 1 - “TELECOM ROOM”	-	CO102 Pewter
ROOM NUMBER SIGN	Text 2 – Room Number	-	White
ROOM NUMBER SIGN	Text 3 – Braille	-	CO102 Pewter

PART 3 - EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Access Flooring	AF
Accordion Folding Partition	AFP
Acoustical Ceiling	AT
Acoustical Ceiling, Special Faced	AT (SP)
Acoustical Metal Pan Ceiling	AMP
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT
Acoustical Wallcovering	AWF
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR
Brick Flooring	BF
Brick Paving	BP
Carpet	CP
Carpet Athletic Flooring	CAF
Carpet Module Tile	CPT
Ceramic Glazed Facing Brick	CGFB
Ceramic Mosaic Tile	FTCT
Concrete	C
Concrete Masonry Unit	CMU
Divider Strips Marble	DS MB
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST

Fabric Wallcovering	WF
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Fluorocarbon	FC
Folding Panel Partition	FP
Foot Grille	FG
Glass Masonry Unit	GUMU
Glazed Face CMU	GCMU
Glazed Structural Facing Tile	SFTU
Granite	GT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Linear Metal Ceiling	LMC
Linear Wood Ceiling	LWC
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC

Natural Finish	NF
Paint	P
Paver Tile	PVT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Polypropylene Fabric Wallcovering	PFW
Porcelain Paver Tile	PPT
Quarry Tile	QT
Radiant Ceiling Panel System	RCP
Resilient Stair Tread	RST
Rubber Base	RB
Rubber Tile Flooring	RT
Spandrel Glass	SLG
Stain	ST
Stone Flooring	SF
Structural Clay	SC

Suspension Decorative Grids Grids	SDG
Terrazzo Portland Cement	PCT
Terrazzo Tile	TT
Terrazzo, Thin Set	
Textured Gypsum Ceiling Panel	TGC
Textured Metal Ceiling Panel	TMC
Thin set Terrazzo	TST
Veneer Plaster	VP

Vinyl Base	VB
Vinyl Coated Fabric Wallcovering	W
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD

3.2 FINSIH SCHEDULE SYMBOLS

Symbol Definition

** Same finish as adjoining walls

- No color required

E Existing

XX To match existing

EFTR Existing finish to remain

RM Remove

3.3 ROOM FINISH SCHEDULE

A. Match adjoining or existing similar surfaces colors, textures or patterns where disturbed or damaged by alterations or new work when not scheduled.

B. ROOM FINISH SCHEDULE

Room No. and Name		FLOOR			BASE		WALL		WAINSCOT		CEILING		REMARKS
		MAT	FC		MAT	FCC	MAT	FCC	MAT	FC	MAT	FCC	
	E X I			N									
				E									

	S T			S								
				W								
				C								
	N E W			N								
				E								
				S								
				W								
				C								
	E X I S T			N								
				E								
				S								
				W								
				C								
	N E W			N								
				E								
				S								
				W								
				C								
	E X IS T			N								
				E								
				S								
				W								

				C								
	N			N								
	E			E								
	S			S								
	W			W								
				C								

--- E N D---

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

1.2 RELATED WORK

1.3 TERMINOLOGY

A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.

C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Studs, runners and accessories.
2. Hanger inserts.
3. Channels (Rolled steel).
4. Furring channels.
5. Screws, clips and other fasteners.

C. Shop Drawings:

1. Typical ceiling suspension system.
2. Typical metal stud and furring construction system including details around openings and corner details.
3. Typical shaft wall assembly
4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.

D. Test Results: Fire rating test designation, each fire rating required for each assembly.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C754.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society For Testing And Materials (ASTM)

A641-09 ..... Zinc-Coated (Galvanized) Carbon Steel Wire

A653/653M-11 ..... Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

C11-10 ..... Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07 ..... Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-08 ..... Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-09 ..... Non-Structural Steel Framing Members

C754-11 ..... Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03(R2008) ..... Installation of Interior Lathing and Furring

C954-10 ..... Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

E580-11 ..... Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G40 or equivalent.

2.2 STEEL STUDS AND RUNNERS (TRACK)

A. ASTM C645, modified for thickness specified and sizes as shown.

1. Use C 645 steel, 0.75 mm (0.0296-inch) minimum base-metal (30 mil).

2. Runners same thickness as studs.
3. Exception: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (Approved May 2012) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C 645. The submission of an evaluation report is acceptable to show conformance to this requirement. Use C 645 steel, 0.48mm (0.019 inch) minimum base-metal (19 mil).

B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.

C. Doubled studs for openings and studs for supporting concrete backer-board.

D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

E. Shaft Wall Framing:
1. Conform to rated wall construction.
2. C-H Studs or C-T Studs.
3. E Studs.
4. J Runners.
5. Steel Jamb-Strut.

2.3 FURRING CHANNELS

A. Rigid furring channels (hat shape): ASTM C645.

B. Resilient furring channels:
1. Not less than 0.45 mm (0.0179-inch) thick bare metal.
2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.

C. "Z" Furring Channels:
1. Not less than 0.45 mm (0.0179-inch)-thick base metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
2. Web furring depth to suit thickness of insulation.

D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

A. ASTM C754, except as otherwise specified.

B. For fire rated construction: Type and size same as used in fire rating test.

C. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.

D. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.

E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.

F. Tie Wire and Hanger Wire:

1. ASTM A641, soft temper, Class 1 coating.
2. Gage (diameter) as specified in ASTM C754 or ASTM C841.

G. Attachments for Wall Furring:

1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.

H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

2.5 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.

B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA

A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.

B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

3.2 INSTALLING STUDS

A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.

B. Space studs not more than 610 mm (24 inches) on center.

C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.

D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions and insulated exterior wall furring.

G. Openings:

1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.
2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.

H. Fastening Studs:

1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.

I. Chase Wall Partitions:

1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
2. Use studs or runners as cross bracing not less than 63 mm (2-1/2 inches wide).

J. Form building seismic or expansion joints with double studs back to back spaced 75 mm (three inches) apart plus the width of the seismic or expansion joint.

K. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY

A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.

B. Wall furring-Stud System:

1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (24 inches) on center.

2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.

C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:
1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.
3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.

D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.

B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.5 INSTALLING SHAFT WALL SYSTEM

A. Conform to UL Design No. U438 for two-hour fire rating.

B. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 600 mm (24 inches) on center.

C. After liner panels have been erected, cut C-H studs and E studs, from 9 mm (3/8-inch) to not more than 13 mm (1/2-inch) less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove.

D. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns, and both sides of closure panels.

E. Suitably frame all openings to maintain structural support for wall:

1. Provide necessary liner fillers and shims to conform to label frame requirements.
2. Frame openings cut within a liner panel with E studs around perimeter.
3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

F. Elevator Shafts:

1. Frame elevator door frames with 0.87 mm (0.0341-inch) thick J strut or J stud jambs having 75 mm (three-inch) long legs on the shaft side.
2. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.
3. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

3.6 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.

1. Space framing at 400 mm (16-inch) centers for metal lath anchorage.
2. Space framing at 600 mm (24-inch) centers for gypsum board anchorage.

B. New exposed concrete slabs:

1. Use metal inserts required for attachment and support of hangers or hanger wires with tied wire loops for embedding in concrete.
2. Furnish for installation under Division 3, CONCRETE.
3. Suspended ceilings under concrete rib construction shall have runner channels at right angles to ribs and be supported from ribs with hangers at ends and at 1200 mm (48-inch) maximum intervals along channels. Stagger hangers at alternate channels.

C. Concrete slabs on steel decking composite construction:

1. Use pull down tabs when available.
2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.

D. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.

E. Existing concrete construction exposed or concrete on steel decking:
   1. Use power actuated fasteners either eye pin, threaded studs or drive pins for type of hanger attachment required.
   2. Install fasteners at approximate mid height of concrete beams or joists. Do not install in bottom of beams or joists.

F. Steel decking without concrete topping:
   1. Do not fasten to steel decking 0.76 mm (0.0299-inch) or thinner.
   2. Toggle bolt to decking 0.9 mm (0.0359-inch) or thicker only where anchorage to steel framing is not possible.

G. Installing suspended ceiling system for gypsum board (ASTM C635 Option):
   1. Install only for ceilings to receive screw attached gypsum board.
   2. Install in accordance with ASTM C636.
      a. Install main runners spaced 1200 mm (48 inches) on center.
      b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.
      c. Install wall track channel at perimeter.

H. Installing Ceiling Bracing System:
   1. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 600 mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.
   2. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.
   3. Brace suspended ceiling or soffit framing in seismic areas in accordance with ASTM E580.

3.7 TOLERANCES

A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.

B. Plumb and align vertical members within 3 mm (1/8-inch.)

C. Level or align ceilings within 3 mm (1/8-inch.)

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SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

B. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

1.3 TERMINOLOGY

A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.

C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Cornerbead and edge trim.
2. Finishing materials.
3. Laminating adhesive.
4. Gypsum board, each type.

C. Shop Drawings:

1. Typical gypsum board installation, showing corner details, edge trim details and the like.
2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
3. Typical shaft wall assembly.
4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.

D. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

E. Test Results:

1. Fire rating test, each fire rating required for each assembly.
2. Sound rating test.

F. Certificates: Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos material.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

In accordance with the requirements of ASTM C840.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing And Materials (ASTM):

C11-15 ..... Terminology Relating to Gypsum and Related Building Materials and Systems

C475-15 ..... Joint Compound and Joint Tape for Finishing Gypsum Board

C840-13 ..... Application and Finishing of Gypsum Board

C919-12 ..... Sealants in Acoustical Applications

C954-15 ..... Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness

C1002-14 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

C1047-14 ..... Accessories for Gypsum Wallboard and Gypsum Veneer Base

C1177-13 ..... Glass Mat Gypsum Substrate for Use as Sheathing

C1178/C1178M-18 ..... Specification for Coated Glass Mat Water Resistant Backing Panel

C1658-13 ..... Glass Mat Gypsum Panels

C1396-14 ..... Gypsum Board

C. Underwriters Laboratories Inc. (UL):

Latest Edition ..... Fire Resistance Directory

D. Inchcape Testing Services (ITS):

Latest Editions ..... Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise.

B. Coreboard or Shaft Wall Liner Panels.

1. ASTM C1396, Type X.
2. ASTM C1658: Glass Mat Gypsum Panels,
3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.

C. Water Resistant Gypsum Backing Board: ASTM C1178, Type X, 16 mm (5/8 inch) thick.

D. Paper facings shall contain 100 percent post-consumer recycled paper content.

2.2 GYPSUM SHEATHING BOARD

A. ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.

B. ASTM C1177, Type X.

2.3 ACCESSORIES

A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.

B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

2.4 FASTENERS

A. ASTM C1002 and ASTM C840, except as otherwise specified.

B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).

C. Select screws of size and type recommended by the manufacturer of the material being fastened.

D. For fire rated construction, type and size same as used in fire rating test.

E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

A. ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

PART 3 - EXECUTION

3.1 GYPSUM BOARD HEIGHTS

A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
   1. Two sides of partitions:
      a. Fire rated partitions.
      b. Smoke partitions.
      c. Sound rated partitions.
      d. Full height partitions shown (FHP).
      e. Corridor partitions.
   2. One side of partitions or furring:
      a. Inside of exterior wall furring or stud construction.
      b. Room side of room without suspended ceilings.
      c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
   3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.
B. In locations other than those specified, extend gypsum board from floor to heights as follows:
   1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.
   2. At ceiling of suspended gypsum board ceilings.
   3. At existing ceilings.

3.2 INSTALLING GYPSUM BOARD

A. Coordinate installation of gypsum board with other trades and related work.
B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
C. Moisture and Mold–Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.
D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
E. Bring gypsum board into contact, but do not force into place.

F. Ceilings:
   1. For single-ply construction, use perpendicular application.
   2. For two-ply assembles:
      a. Use perpendicular application.
      b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.

G. Walls (Except Shaft Walls):
   1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
   2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.
   3. Stagger screws on abutting edges or ends.
   4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
   5. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
   6. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
   7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
   8. Installing Two Layer Assembly Over Sound Deadening Board:
      a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.
      b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.
   9. Control Joints ASTM C840 and as follows:

a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.
b. Not required for wall lengths less than 9000 mm (30 feet).
c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.

H. Acoustical or Sound Rated Partitions, Fire and Smoke Partitions:
1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.
2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.

I. Electrical and Telecommunications Boxes:
1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:
1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
2. Install in one piece, without the limits of the longest commercially available lengths.
3. Corner Beads:
a. Install at all vertical and horizontal external corners and where shown.
b. Use screws only. Do not use crimping tool.
4. Edge Trim (casings Beads):
a. At both sides of expansion and control joints unless shown otherwise.
b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
d. Where shown.

3.3 INSTALLING GYPSUM SHEATHING

A. Install in accordance with ASTM C840, except as otherwise specified or shown.
B. Use screws of sufficient length to secure sheathing to framing.

C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.

D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.

E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

3.4 CAVITY SHAFT WALL

A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.

B. Conform to UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Nonbearing for two-hour fire rating. Conform to FM WALL CONSTRUCTION 25-1/HR (Non-loadbearing) for one-hour fire rating where shown.

C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.

1. Where shaft walls exceed 4300 mm (14 feet) in height, position panel end joints within upper and lower third points of wall.
2. Stagger joints top and bottom in adjacent panels.
3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.

D. Gypsum Board:

1. Two-hour wall:
   a. Erect base layer (backing board) vertically on finish side of wall with end joints staggered. Fasten base layer panels to studs with 25 mm (one inch) long screws, spaced 600 mm (24 inches) on center.
   b. Use laminating adhesive between plies in accordance with UL or FM if required by fire test.
   c. Apply face layer of gypsum board required by fire test vertically over base layer with joints staggered and attach with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.

2. One hour wall with one layer on finish side of wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 300 mm (12 inches) on center in field and along edges.
3. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.

E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.

3.5 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for al finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:
   1. Gypsum board is fastened and held close to framing or furring.
   2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non-decorated smoke barrier, fire rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated construction. Sanding is not required of non-decorated surfaces.

3.6 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.

B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non-decorated surface to provide fire protection equivalent to the fire rated construction.

3.7 UNACCESSIBLE CEILINGS

At Mental Health and Behavioral Nursing Units, areas accessible to patients and not continuously observable by staff (e.g., patient bedrooms, day rooms), ceilings should be a solid

material such as gypsum board. This will limit patient access. Access doors are needed to access electrical and mechanical equipment above the ceiling. These doors should be locked to prevent unauthorized access and secured to ceiling using tamper resistant fasteners.

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SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base (RB) adhered to interior walls and partitions.

1.2 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

F1344-15 ..... Rubber Floor Tile.

F1859-14e1 ..... Rubber Sheet Floor Covering without Backing.

F1860-14e1 ..... Rubber Sheet Floor Covering with Backing.

F1861-16 ..... Resilient Wall Base.

D4259-18..... Preparation of Concrete by Abrasion Prior to Coating Application.

C. Federal Specifications (Fed. Spec.):

RR-T-650E (1994) ..... Treads, Metallic and Non-Metallic, Skid-Resistant.

D. International Concrete Repair Institute (ICRI):

310.2R-2013..... Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.3 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Description of each product.
2. Adhesives and primers indicating manufacturer's recommendation for each application.
3. Installation instructions.

C. Samples:

1. Resilient Base: 150 mm (6 inches) long, each type and color.
2. Resilient Stair Treads: 150 mm (6 inches) long, each type and color.
3. Sheet Rubber Flooring: 300 mm (12 inches) square, each type and color.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
   a. Stair Treads and Sheet Rubber Flooring: Submit Floor Score label.
   b. Show volatile organic compound types and quantities.

E. Operation and Maintenance Data:
1. Care instructions for each exposed finish product.

1.4 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.
B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.5 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.
B. Protect products from damage when handling and during construction operations.

1.6 FIELD CONDITIONS

A. Environment:
1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

1.7 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Provide each product from one manufacturer and from one production run.
C. Provide resilient stair treads and sheet rubber flooring from same manufacturer.
D. Sustainable Construction Requirements:

1. Sheet Rubber Flooring Recycled Content: 90 percent total recycled content, minimum.
2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
    a. Flooring Adhesives and Sealants.

2.2 RESILIENT BASE

A. Resilient Base: 3 mm (1/8 inch) thick, 100 mm (4 inches) high.
    1. Type: Rubber or vinyl; use one type throughout.
    2. ASTM F1861, Type TP thermoplastic rubber or Type TV thermoplastic vinyl, Group 2 - layered.
B. Applications:
    1. Carpet Flooring Locations: Style A - Straight.
    2. Other Locations: Style B - Cove.

2.3 PRIMER (FOR CONCRETE FLOORS)

A. Primer: Type recommended by adhesive manufacturer.

2.4 LEVELING COMPOUND (FOR CONCRETE FLOORS)

A. Leveling Compound: Provide products mixed with latex or polyvinyl acetate resins.

2.5 ADHESIVES

A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.
B. Protect existing construction and completed work from damage.
C. Remove existing base to permit new installation.
    1. Dispose of removed materials.
D. Correct substrate deficiencies.
    1. Fill cracks, pits, and depressions with leveling compound.
    2. Remove protrusions; grind high spots.
    3. Apply leveling compound to achieve 3 mm (1/8 inch) in 3 m (10 feet) maximum surface variation.
E. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

1. Mechanically clean concrete floor substrate according to ASTM D4259.
2. Surface Profile: ICRI Guideline No. 310.2R.

F. Allow substrate to dry and cure.

G. Perform flooring manufacturer’s recommended bond, substrate moisture content, and pH tests.

3.2 INSTALLATION GENERAL

A. Install products according to manufacturer's instructions.

1. When instructions deviate from specifications, submit proposed resolution for Contracting Officer consideration.

3.3 RESILIENT BASE INSTALLATION

A. Applications:

1. Install resilient base in rooms scheduled on Drawings.
2. Install resilient base on curb supported fixed equipment.
3. Extend resilient base into closets, alcoves, and cabinet knee spaces, and around columns within scheduled room.

B. Lay out resilient base with minimum number of joints.

1. Length: 600 mm (24 inches) minimum, each piece.
2. Locate joints 150 mm (6 inches) minimum from corners and intersection of adjacent materials.

C. Installation:

1. Apply adhesive uniformly for full contact between resilient base and substrate.
2. Set resilient base with hairline butted joints aligned along top edge.

D. Field, Factory form corners and end stops.

1. V-groove back of outside corner.
2. V-groove face of inside corner and notch cove for miter joint.

E. Roll resilient base ensuring complete adhesion.

3.4 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed resilient base surfaces. Remove contaminants and stains.

1. Clean with mild detergent. Leave surfaces free of detergent residue.

C. Polish exposed resilient base to gloss sheen.

3.5 PROTECTION

A. Protect products from construction traffic and operations.

1. Maintain protection until directed by Contracting Officer's Representative.

B. Replace damaged products and re-clean.

1. Damaged Products include cut, gouged, scraped, torn, and unbonded products.

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SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the installation of static-control vinyl tile flooring, and accessories required for a complete installation.

1.2 RELATED WORK:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

C. Subfloor Testing and Preparation: Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

D. Color, Pattern and Texture for Resilient Tile Flooring and Accessories: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as described in PART 2 - PRODUCTS.
2. Postconsumer and pre-consumer recycled content as described in PART 2 - PRODUCTS.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Resilient material manufacturer’s recommendations for adhesives, underlayment, primers, and polish.
3. Application, installation and maintenance instructions.

D. Samples:

1. Tile: Each type, color, thickness and finish.
2. Edge Strips: Each type, color, thickness and finish.
3. Feature Strips: Each type, color, thickness and finish.

E. Shop Drawings:

1. Layout of patterns as shown on the construction documents.
2. Edge strip locations showing types and detail cross sections.

F. Test Reports:

1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory. Tested per ASTM F510/F510M.
2. Moisture and pH test results as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1.4 DELIVERY:

A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.

B. Materials from containers which have been distorted, damaged or opened prior to installation are not acceptable.

1.5 STORAGE:

A. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A company specializing in installation with minimum three (3) years' experience and employs experienced flooring installers who have retained, and currently hold, an INSTALL Certification, or a certification from a comparable certification program.

1. Installers to be certified by INSTALL or a comparable certification program with the following minimum criteria:

a. US Department of Labor approved four (4) year apprenticeship program, 160 hours a year.

b. Career long training.

c. Manufacturer endorsed training.

d. Fundamental journeyman skills certification.

B. Furnish product type materials from the same production run.

1.7 WARRANTY:

A. Construction Warranty: Comply with FAR clause 52.246-21, "Warranty of Construction".

1.8 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

D2047-11.....Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

D2240-05(R2010).....Test Method for Rubber Property—Durometer Hardness

D4078-02(R2008).....Water Emulsion Floor Finish

E648-14c .....Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

E662-14 .....Specific Optical Density of Smoke Generated by Solid Materials

E1155/E1155M-14 .....Determining Floor Flatness and Floor Levelness Numbers

F510/F510M-14 .....Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method

F710-11 .....Preparing Concrete Floors to Receive Resilient Flooring

F925-13 .....Test Method for Resistance to Chemicals of Resilient Flooring

F1344-12(R2013).....Rubber Floor Tile

F1700-13a .....Solid Vinyl Floor Tile

F1869-11 .....Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-11 .....Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes

F2195-13 .....Linoleum Floor Tile

C. Code of Federal Regulation (CFR):

40 CFR 59 .....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

D. International Standards and Training Alliance (INSTALL):

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Provide adhesives, underlayment, primers, and polish recommended by resilient floor material manufacturer.

B. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.

C. Smoke Density: Less than 450 per ASTM E662.

D. Slip Resistance – Not less than 0.5 when tested with ASTM D2047.

2.2 VINYL COMPOSITION TILE (VCT):

A. Tile Standard: ASTM F1700.

B. Thickness: 3.2 mm (0.125 inch).

C. Size: 305 x 305 mm (12'x12').

D. Type: Static control or static dissipative type.

2.3 ADHESIVES:

A. Provide water resistant type adhesive for flooring, base and accessories as recommended by the manufacturer to suit substrate conditions. VOC content to be less than the 50 grams/L when calculated according to 40 CFR 59 (EPA Method 24). Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

2.4 PRIMER FOR CONCRETE SUBFLOORS:

A. Provide in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

2.5 LEVELING COMPOUND FOR CONCRETE FLOORS:

A. Provide cementitious products with latex or polyvinyl acetate resins in the mix in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

2.6 POLISH AND CLEANERS:

A. Cleaners: As recommended in writing by floor tile manufacturer.

B. Polish: ASTM D4078.

2.7 MOULDING:

A. Provide tapered mouldings of vinyl for transitions of flooring materials specified. Provide vertical lip on moulding of maximum 6 mm (1/4 inch). Provide bevel change in level between 6 and 13 mm (1/4 and 1/2 inch) with a slope no greater than 1:2.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS:

A. Maintain flooring materials and areas to receive resilient flooring at a temperature above 20 degrees C (68 degrees F) for three (3) days before application, during application and two (2) days after application, unless otherwise directly by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 13 degrees C (55 degrees F) thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

B. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

3.2 SUBFLOOR TESTING AND PREPARATION:

A. Prepare and test surfaces to receive resilient tile and adhesive as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1. Remove existing resilient floor and existing adhesive.

B. Prepare concrete substrates in accordance with ASTM F710.

3.3 INSTALLATION:

A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.

B. Mix tile from at least two containers. An apparent line either of shades or pattern variance is not acceptable.

C. Tile Layout:

1. If layout is not shown on construction documents, lay tile symmetrically about center of room or space with joints aligned.
2. Vary edge width as necessary to maintain full size tiles in the field, no edge tile to be less than 1/2 the field tile size, except where irregular shaped rooms make it impossible.
3. Place tile pattern in the same direction; do not alternate tiles unless specifically indicated in the construction documents to the contrary. Match tile installation to existing pattern, where applicable.

D. Application:

1. Adhere floor tile to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
2. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
3. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
4. Roll tile floor with a minimum 45 kg (100 pound) roller.

E. Seal joints at pipes with sealants in accordance with Section 07 92 00, JOINT SEALANTS.

F. Installation of Edge Strips:

1. Locate edge strips under center line of doors unless otherwise shown on construction documents.
2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws.

3. Where tile edge is exposed, butt edge strip to touch along tile edge.
4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

3.4 CLEANING AND PROTECTION:

A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.

B. Keep traffic off resilient material for a minimum 72 hours after installation.

C. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer's written instructions.

D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by COR. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by COR.

E. When protective materials are removed and immediately prior to acceptance, replace damaged tile and mouldings, re-clean resilient materials.

3.5 LOCATION:

A. Unless otherwise indicated in construction documents, install tile flooring, under areas where casework, laboratory and pharmacy furniture and other equipment occur.

B. Extend tile flooring for room into adjacent closets and alcoves.

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SECTION 09 66 00
STATIC DISSIPATIVE SEALER FOR CONCRETE SUBSTRATES

PART 1 - GENERAL

1.1 SECTIONS

A. Static Dissipative floor coating system for interior concrete slabs.

1.2 RELATED SECTIONS

A. Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

1.3 REFERENCES

A. ANSI-ESD STM7.1-2013 - Electrical resistance, flooring.

B. ANSI/ESD S20.20-2014, ESD control program.

C. ANSI/ESD STM97.2, static generation

D. ASTM F-1869-04 - Concrete vapor emission test method.

E. ASTM D-968-17, abrasion resistance.

1.4 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures

B. Product Data: Submit manufacturer's product data including physical properties, electrical properties and application instructions.

1.5 QUALITY ASSURANCE

A. Applicators Qualifications: Ensure applicators qualifications by one of the following:

1. Use applicator experienced in application of similar materials for a minimum of 5 years on projects of similar size and complexity. Submit list of completed projects including project name and location, name of Architect, name of material manufacturer and approximate quantity of materials applied.
2. Submit letter of approval from manufacturer stating applicator is qualified to apply the specified materials.

B. Applicators Personnel: Employ persons trained for application of specific materials.

C. Pre-application Meeting: Convene a pre-application meeting before start of application of static control flooring system. Require attendance of parties directly affecting work in this section, including Contractor and applicator. Review surface preparation, application, application timeframe, curing, protection and coordination with other work. Contact manufacturer with questions pertaining to application and usage of these products.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly identifying product name, manufacturer, batch or dye lot numbers and SDS sheets.

B. Storage: Store materials in accordance with manufacturer's instructions. Keep containers sealed until ready for use.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.7 ENVIRONMENTAL CONDITIONS

A. Ensure environment is fully enclosed; weather-tight, well-lighted and air temperatures at time of installation are between 60 and 80 degrees F.

PART 2 - PRODUCTS

2.1 HEAVY DUTY STATIC CONTROL CONCRETE SEALANT

A. Static control concrete sealer.

1. Enhanced urethane concrete sealer.
2. Electrical Resistance per ANSI-ESD STM7.1-2018, >1.0E04, <1.0E09 Ohms.
3. Available colors: Translucent

B. Product Specifications

Nonvolatile Solids	25% +/- 0.6%
VOC Content	Meets CDHP V1.2 See Test Results
Total Active	30.1% +/- 1.6%
Typical resistivity as applied to concrete ANSI ESD S7.1 (point to point and resistance to ground) @ 100 VDC	>1.0E04 and < 1.0E09 Ohms @ 40% Relative Humidity
Static Dissipation	< 0.3 Second
pH	8.4 - 9.0
Gloss 60	85+ @ 3 coats
Color	Translucent
Weight Per Gallon	8.55 - 8.8

Slip Resistance (ASTM)	0.65 Minimum (excellent)
Stability	2 year minimum at room temperature
Freeze/Thaw Stability	3 cycles minimum
Drying Time Between Coats	1 Hour
Water Resistance	Good
Gallon Coverage (Feet 2)	1500 - 2000 per gallon per coat
Abrasion Resistance, ASTM D968-17	6,480 grams

PART 3 - PART THREE: EXECUTION

3.1 EXAMINATION

A. Examine substrate to receive static control coating system. Do not begin preparation or application until conditions are acceptable.

B. Pre-application Product Testing: Mask off a 36" x 36" test area. Apply three thin coats of sealer. Pre-test material bond strength to substrate per manufacturer instructions. Test Electrical conductivity to ANSI-ESD STM7.1-2018 - Point to Point Electrical Resistance, flooring. Contact manufacturer should results exceed >1.0E09 Ohms.

C. Test vapor emission of concrete slab per calcium chloride test method ASTM F-1869 or ASTM F2170. Should concrete vapor emissions results exceed 9 lbs. per 1,000 SF/24-hour period (90% per latest version of ASTM F2170 in-situ relative humidity test) contact United SCP prior to proceeding with installation.

D. Ensure new concrete has the following properties:

1. Maximum water/cement ratio of 0.45
2. Cured 60 days at a minimum of 60 degrees F.
3. Minimum compressive strength of 3,500 PSI.
4. Minimum tensile strength of 200 PSI.

3.2 SURFACE PREPARATION

A. Prepare substrates in accordance with manufacturer's instructions.

B. Ensure substrate is clean, free of dirt, oil, grease, wax and other compounds which may inhibit bonding to substrate.

C. Repair cracked and eroded concrete in accordance with manufacturer's instructions. Remove and repair unsound substrates.

3.3 APPLICATION

A. Mask all encumbrances such as existing wall base and columns prior to application of coatings in accordance with manufacturer's instructions.

B. Install electrical grounding foil in accordance with manufacturer's recommended grounding methods. Use two ground connections for small areas (<3,000 square feet) and one additional ground connection for every 3,000 square feet thereafter.

C. Ensure that concrete or other substrate is visibly dry.

D. Do not add thinners to any component of this conductive floor coating system.

E. Apply 1st coat to prepared concrete per manufacturer’s recommended guidelines. Do not over apply - apply a thin even coat. Allow to cure for at least 1 hour prior to proceeding.

F. Apply 2nd coat per manufacturer’s recommended guidelines. Do not over apply - apply a thin even coat. Allow to cure at least 1 hour prior to proceeding.

G. Apply 3rd coat per manufacturers recommended guidelines. Do not over apply - apply a thin even coat. Allow to cure at least 1 hour prior to proceeding.

3.4 TESTING

A. Test the flooring to compliance with ANSI/ESD S20.20-2014 per test method ANSI-ESD STM7.1-2013 (Table 3 page 6, electrical resistance point-to-point and electrical resistance to ground).

3.5 PROTECTION

A. Protect floor coating system while curing and especially during move in of heavy equipment.

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SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:

1. Prime coats which may be applied in shop under other sections.
2. Prime painting unprimed surfaces to be painted under this Section.
3. Painting items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
4. Painting ferrous metal (except stainless steel) exposed to view.
5. Painting galvanized ferrous metals exposed to view.
6. Painting interior concrete block exposed to view.
7. Painting gypsum drywall exposed to view.
8. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
9. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
10. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers lighting fixtures, and the like, which are exposed to view through these items.
11. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
13. Painting of any surface not specifically mentioned to be painted herein or on construction documents, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, is to be included as though specified.

1.2 RELATED WORK

A. Section 01 35 26, SAFETY REQUIREMENTS: Activity Hazard Analysis.

B. Section 01 81 13, SUSTAINABLE CONSTUCTION REQUIREMENTS: Sustainable Design Requirements.

C. Section 08 14 00, INTERIOR WOOD DOORS: Prefinished flush doors with transparent finishes.

D. Section 09 06 00, SCHEDULE FOR FINISHES: Type of Finish, Color, and Gloss Level of Finish Coat.

E. Division 10 SPECIALTIES: Shop prime painting of steel and ferrous metals.

F. Division 21 FIRE SUPPRESSION: Shop prime painting of steel and ferrous metals.

G. Division 22 PLUMBING: Shop prime painting of steel and ferrous metals.

H. Division 23 HEATING; VENTILATION AND AIR-CONDITIONING: Shop prime painting of steel and ferrous metals.

I. Division 26 ELECTRICAL: Shop prime painting of steel and ferrous metals.

J. Division 27 COMMUNICATIONS: Shop prime painting of steel and ferrous metals.

K. Division 28 ELECTRONIC SAFETY AND SECURITY: Shop prime painting of steel and ferrous metals.

L. Section 32 17 23, PAVEMENT MARKINGS: Asphalt and concrete pavement marking.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Painter qualifications.

D. Manufacturer's Literature and Data:

1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.

E. Sample Panels:

1. After painters' materials have been approved and before work is started, submit sample panels showing each type of finish and color specified.
2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).
3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge

grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.

4. Attach labels to panel stating the following:
   a. Federal Specification Number or manufacturers name and product number of paints used.
   b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
   c. Product type and color.
   d. Name of project.
5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.

F. Sample of identity markers if used.

G. Manufacturers' Certificates indicating compliance with specified requirements:
   1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
   2. High temperature aluminum paint.
   3. Epoxy coating.
   4. Intumescent clear coating or fire-retardant paint.
   5. Plastic floor coating.

1.4 DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer.
   2. Product type.
   3. Batch number.
   4. Instructions for use.
   5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:
   1. Federal Specification Number, where applicable, and name of material.
   2. Surface upon which material is to be applied.
   3. Specify Coat Types: Prime; body; finish; etc.

C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

1.5 QUALITY ASSURANCE

A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.

B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 REGULATORY REQUIREMENTS

A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC) Emissions Requirements: Field-applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.
2. Lead-Base Paint:
   a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
   b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
   c. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
   d. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
3. Asbestos: Provide materials that do not contain asbestos.

4. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
5. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
6. Use high performance acrylic paints in place of alkyd paints.

1.7 SAFETY AND HEALTH

A. Apply paint materials using safety methods and equipment in accordance with the following:
   1. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified in Section 01 35 26, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.
B. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.
C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
   1. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
   2. 29 CFR 1910.1000.
   3. ACHIH-BKLT and ACGHI-DOC, threshold limit values.

1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
B. American Conference of Governmental Industrial Hygienists (ACGIH):

   ACGIH TLV-BKLT-2012 ..... Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

   ACGIH TLV-DOC-2012 ..... Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
C. ASME International (ASME):

   A13.1-07(R2013) ..... Scheme for the Identification of Piping Systems
D. Code of Federal Regulation (CFR):

   40 CFR 59 ..... Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
E. Commercial Item Description (CID):

   A-A-1272A ..... Plaster Gypsum (Spackling Compound)

F. Federal Specifications (Fed Spec):

TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

G. Master Painters Institute (MPI):

1 .....Aluminum Paint

3 .....Primer, Alkali Resistant, Water Based

4 .....Interior/ Exterior Latex Block Filler

5 .....Exterior Alkyd Wood Primer

6 .....Exterior, Latex for Exterior Wood Primer

7 .....Exterior Oil Wood Primer

8 .....Exterior Alkyd, Flat MPI Gloss Level 1

9 .....Exterior Alkyd Enamel MPI Gloss Level 6

10 .....Exterior Latex, Flat

11 .....Exterior Latex, Semi-Gloss

15 .....Exterior Latex, Low Sheen (MPI Gloss Level 3-4)

17 .....Primer, Bonding, Waterbased

18 .....Organic Zinc Rich Primer

22 .....Aluminum Paint, High Heat (up to 590% - 1100F)

23 .....Primer, Metal, Surface Tolerant

27 .....Exterior / Interior Alkyd Floor Enamel, Gloss

31 .....Polyurethane, Moisture Cured, Clear Gloss

36 .....Knot Sealer

39 .....Primer, Latex, for Interior Wood

40 .....Exterior, Latex High Build

42 .....Textured Coating, Latex, Flat

43 .....Interior Satin Latex, MPI Gloss Level 4

44 .....Interior Low Sheen Latex, MPI Gloss Level 2

45 .....Interior Primer Sealer

46 .....Interior Enamel Undercoat

47 .....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5

48 .....Interior Alkyd, Gloss, MPI Gloss Level 6

50 .....Interior Latex Primer Sealer

51 .....Interior Alkyd, Eggshell, MPI Gloss Level 3

52 .....Interior Latex, MPI Gloss Level 3

53 .....Interior Latex, Flat, MPI Gloss Level 1

54 .....Interior Latex, Semi-Gloss, MPI Gloss Level 5

59 .....Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss

60 .....Interior/Exterior Latex Porch & Floor Paint, Low Gloss

66 .....Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved)

67 .....Interior Latex Fire Retardant, Top-Coat (ULC Approved)

68 .....Interior/ Exterior Latex Porch & Floor Paint, Gloss

71 .....Polyurethane, Moisture Cured, Clear, Flat

77 .....Epoxy Cold Cured, Gloss

79 .....Marine Alkyd Metal Primer

90 .....Interior Wood Stain, Semi-Transparent

91 .....Wood Filler Paste

94 .....Exterior Alkyd, Semi-Gloss

95 .....Fast Drying Metal Primer

98 .....High Build Epoxy Coating

99 .....Sealer, Water-based, for Concrete Floors

101 .....Epoxy Anti-Corrosive Metal Primer

107 .....Primer, Rust-Inhibitive, Water-based

108 .....High Build Epoxy Coating, Low Gloss

113 .....Elastomeric, Pigmented, Exterior, Water-based, Flat

114 .....Interior Latex, Gloss

115 .....Epoxy-Modified Latex, Interior Gloss (MPI gloss level 6)

118 .....Dry Fall, Latex Flat

119 .....Exterior Latex, High Gloss (acrylic)

134 .....Galvanized Water Based Primer

135 .....Non-Cementitious Galvanized Primer

138 .....Interior High Performance Latex, MPI Gloss Level 2

139 .....Interior High Performance Latex, MPI Gloss Level 3

140 .....Interior High Performance Latex, MPI Gloss Level 4

141 .....Interior High Performance Latex (SG) MPI Gloss Level 5

144 .....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 2)

145 .....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 3)

146 .....Latex, Interior, Institutional Low Odor / VOC, (MPI Gloss Level 4)

151 .....Light Industrial Coating, Interior, Water-based, (MPI Gloss Level 3)

153 .....Light Industrial Coating, Interior, Water-based, (MPI Gloss Level 4)

163 .....Exterior Water Based Semi-Gloss Light Industrial Coating, MPI Gloss Level 5

164 .....Exterior, Water Based, Gloss, Light Industrial Coating, MPI Gloss Level 6

H. Society for Protective Coatings (SSPC):

SSPC SP 1-82(R2004).....Solvent Cleaning

SSPC SP 2-82(R2004).....Hand Tool Cleaning

SSPC SP 3-28(R2004).....Power Tool Cleaning

SSPC SP 10/NACE No.2.....Near-White Blast Cleaning

SSPC PA Guide 10.....Guide to Safety and Health Requirements

I. Maple Flooring Manufacturer's Association (MFMA):

J. U.S. National Archives and Records Administration (NARA):

29 CFR 1910.1000 .....Air Contaminants

K. Underwriter's Laboratory (UL)

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

2.2 PAINT PROPERTIES:

A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

C. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only to recommended limits.

D. VOC Content: For field applications that are inside the weatherproofing system, paints and coating to comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Flat Paints and Coatings: 50 gram/liter.
   2. Non-flat Paints and Coatings: 150 gram/liter.
   3. Dry-Fog Coatings: 400 gram/liter.
   4. Primers, Sealers, and Undercoaters: 200 gram/liter.
   5. Anticorrosive and Antirust Paints applied to Ferrous Metals: 250 gram/liter.
   6. Zinc-Rich Industrial Maintenance Primers: 340 gram/liter.
   7. Pretreatment Wash Primers: 420 gram/liter.
   8. Shellacs, Clear: 730 gram/liter.
   9. Shellacs, Pigmented: 550 gram/liter.

E. VOC test method for paints and coatings is to be in accordance with 40 CFR 59 (EPA Method 24). Part 60, Appendix A with the exempt compounds' content determined by Method 303 (Determination of Exempt Compounds) in the South Coast Air Quality Management District's (SCAQMD) "Laboratory Methods of Analysis for Enforcement Samples" manual.

2.3 PLASTIC TAPE:

A. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.

B. Pressure sensitive adhesive back.

C. Widths as shown on construction documents.

PART 3 - EXECUTION

3.1 JOB CONDITIONS:

A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
   1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
   2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.

B. Atmospheric and Surface Conditions:
   1. Do not apply coating when air or substrate conditions are:
      a. Less than 3 degrees C (5 degrees F) above dew point.

b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.

c. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer’s printed instructions.

2. Maintain interior temperatures until paint dries hard.
3. Do no exterior painting when it is windy and dusty.
4. Do not paint in direct sunlight or on surfaces that the sun will warm.
5. Apply only on clean, dry and frost-free surfaces except as follows:
   a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces only when allowed by manufacturer's printed instructions.
   b. Concrete and masonry when permitted by manufacturer’s recommendations, dampen surfaces to which water thinned acrylic and cementitious paints are applied with a fine mist of water on hot dry days to prevent excessive suction and to cool surface.
6. Varnishing:
   a. Apply in clean areas and in still air.
   b. Before varnishing vacuum and dust area.
   c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 INSPECTION:

A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.3 GENERAL WORKMANSHIP REQUIREMENTS:

A. Application may be by brush or roller. Spray application only upon acceptance from the COR in writing.

B. Furnish to the COR a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.

C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.

D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

E. When indicated to be painted, remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.

F. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.

G. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.

H. All coats are to be dry to manufacturer's recommendations before applying succeeding coats.

I. All suction spots or "hot spots" in plaster after the application of the first coat are to be touched up before applying the second coat.

J. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.4 SURFACE PREPARATION:

A. General:

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.
2. See other sections of specifications for specified surface conditions and prime coat.
3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   a. Concrete: 12 percent.

b. Fiber-Cement Board: 12 percent.

c. Masonry (Clay and CMU's): 12 percent.

d. Wood: 15 percent.

e. Gypsum Board: 12 percent.

f. Plaster: 12 percent.

B. Wood:

1. Sand to a smooth even surface and then dust off.
2. Sand surfaces showing raised grain smooth between each coat.
3. Wipe surface with a tack rag prior to applying finish.
4. Surface painted with an opaque finish:
   a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
   b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
   a. Thin filler in accordance with manufacturer's instructions for application.
   b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
   a. Fill flat head countersunk screws used for permanent anchors.

b. Do not fill screws of item intended for removal such as glazing beads.

4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

D. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three (3) days and brush thoroughly free of crystals.
5. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Division 03, CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

E. Gypsum Plaster and Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION:

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.

E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COR in writing.

1. Apply painting materials specifically required by manufacturer to be applied by spraying.
2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in “Building and Structural Work Field Painting”; “Work not Painted”; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING:

A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.

E. Wood and Wood Particleboard:

1. Use same kind of primer specified for exposed face surface.

a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5(Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent) is scheduled.
b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
c. Transparent finishes as specified under "Transparent Finishes on Wood Except Floors Article" and "Finish for Wood Floors Article".

2. Apply two (2) coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
3. Apply one (1) coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (UL Approved) to wood for fire retardant finish.

F. Gypsum Board:
1. Surfaces scheduled to have MPI 53 (Interior Latex, Flat), MPI Gloss Level 3).
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer).

G. Gypsum Plaster and Veneer Plaster:
1. Surfaces scheduled to receive vinyl coated fabric wall covering: Use MPI 45 (Interior Primer Sealer).
2. MPI 45 (Interior Primer Sealer), except use MPI 50 (Interior Latex Primer Sealer) when an alkyd flat finish is specified.
3. Surfaces scheduled to have MPI 52 (Interior Latex, MPI Gloss Level 3)

3.8 INTERIOR FINISHES:

A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Gypsum Board:

1. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3).
2. Two (2) coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2).
3. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss).
4. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).

C. Wood:

1. Sanding:
   a. Use 220-grit sandpaper.
   b. Sand sealers and varnish between coats.
   c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
2. Sealers:
   a. MPI 31 (gloss) or MPI 71 (flat) thinned as recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.
   b. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
   c. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
   d. Sand as specified.
3. Paint Finish:
   a. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 47 (Interior Alkyd, Semi-Gloss.
   b. One (1) coat MPI 66 (Interior Alkyd Fire retardant, Clear Top-Coat (UL Approved) and above ceilings where shown.
   c. One (1) coat of MPI 45 Interior Primer Sealer) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).
   d. Two (2) coats of MPI 51 (Interior Alkyd, Eggshell).

D. Miscellaneous:

1. Apply where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2. MPI 1 (Aluminum Paint): Two (2) coats of aluminum paint.
3. Existing acoustical units scheduled to be repainted except acoustical units with a vinyl finish:
   a. Clean units free of dust, dirt, grease, and other deterrents to paint adhesion.

3.9 REFINISHING EXISTING PAINTED SURFACES:

A. Clean, patch and repair existing surfaces as specified under "Surface Preparation". No "telegraphing" of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, sand smooth and re-finish until surface meets with COR's approval.
B. Remove and reinstall items as specified under "General Workmanship Requirements".
C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one (1) coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss).
G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
I. Sand or dull glossy surfaces prior to painting.
J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.10 PAINT COLOR:

A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.
B. For additional requirements regarding color see Articles, "REFINISHING EXISTING PAINTED SURFACE" and "MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE".
C. Coat Colors:
   1. Color of priming coat: Lighter than body coat.
   2. Color of body coat: Lighter than finish coat.

3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:

1. Paint to match color of casework where casework has a paint finish.
2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.11 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE:

A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.

B. In spaces not scheduled to be finish painted in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified below.

C. Paint various systems specified in Division 02 – EXISTING CONDITIONS, Division 21 – FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 – HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 – ELECTRONIC SAFETY AND SECURITY.

D. Paint after tests have been completed.

E. Omit prime coat from factory prime-coated items.

F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.

G. Omit field painting of items specified in “BUILDING AND STRUCTURAL WORK FIELD PAINTING”; “Building and Structural Work not Painted”.

H. Color:

1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:
   a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.

b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.

c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

d. Federal Safety Red: Exposed fire protection piping, hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.

e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.

f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

3.12 IDENTITY PAINTING SCHEDULE:

A. Identify designated service in new buildings or projects with extensive remodeling in accordance with ASME A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels. For existing spaces where work is minor match existing.

1. Legend may be identified using snap-on coil plastic markers or by paint stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12.2 M (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow using black stencil paint.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on construction documents where asterisk appears for High, Medium, and Low Pressure designations as follows:

   a. High Pressure - 414 kPa (60 psig) and above.

   b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).

   c. Low Pressure - 103 kPa (14 psig) and below.

d. Add Fuel oil grade numbers.

6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
Blow-off		Green	White	Blow-off
Boiler Feedwater		Green	White	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Blue	White	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High Pressure Steam		Green	White	H.P. _____*
High Pressure Condensate Return		Green	White	H.P. Ret ____*
Medium Pressure Steam		Green	White	M. P. Stm ____*
Medium Pressure Condensate Return		Green	White	M.P. Ret _____*
Low Pressure Steam		Green	White	L.P. Stm _____*
Low Pressure Condensate Return		Green	White	L.P. Ret _____*
High Temperature Water Supply		Green	White	H. Temp Wtr Sup
High Temperature Water Return		Green	White	H. Temp Wtr Ret
Hot Water Heating Supply		Green	White	H. W. Htg Sup
Hot Water Heating Return		Green	White	H. W. Htg Ret
Gravity Condensate Return		Green	White	Gravity Cond Ret
Pumped Condensate Return		Green	White	Pumped Cond Ret
Vacuum Condensate Return		Green	White	Vac Cond Ret
Fuel Oil (Diesel Fuel included under Fuel Oil)		Brown	White	Fuel Oil
Boiler Water Sampling		Green	White	Sample

Chemical Feed		Green	White	Chem Feed
Continuous Blow-Down		Green	White	Cont. B D
Pumped Condensate		Green	White	Pump Cond
Pump Recirculating		Green	White	Pump-Recirc.
Vent Line		Green	White	Vent
Alkali		Orange	Black	Alk
Bleach		Orange	Black	Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr
Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Orange	Black	Acid Waste
Vent		Orange	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Silver Rec
Oral Evacuation		Green	White	Oral Evac
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler	Red	Red	White	Auto Spr
Standpipe	Red	Red	White	Stand
Sprinkler	Red	Red	White	Drain
Hot Water Supply Dom.				
Solar Water		Green	White	H.W. Sup Dom/SW
Hot Water Return Dom.				

Solar Water	Green	White	H.W. Ret Dom/SW

7. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6096 mm (20 foot) intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class, 5000.
8. See Sections for methods of identification, legends, and abbreviations of the following:
   a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.
   b. Dental compressed air lines: Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING / Section 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT.
   c. Laboratory gas and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   d. Oral evacuation lines: Section 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT.
   e. Medical Gases and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
   f. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY.

B. Fire and Smoke Partitions:
   1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
   2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
   3. Locate not more than 6096 mm (20 feet) on center on corridor sides of partitions, and with a least one (1) message per room on room side of partition.
   4. Use semi-gloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:
   1. Apply stenciled number and letters to correspond with grid numbering and lettering indicated on construction documents.

2. Paint numbers and letters 101 mm (4 inches) high, locate 45 mm (18 inches) below overhead structural slab.
3. Apply on four (4) sides of interior columns and on inside face only of exterior wall columns.
4. Color:
   a. Use black on concrete columns.
   b. Use white or contrasting color on steel columns.

3.13 PROTECTION CLEAN UP, AND TOUCH-UP:

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies interior signage for room numbers, directional signs exterior signage, code required signs and temporary signs.

B. This section specifies exterior signage.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 05 12 00, STRUCTURAL STEEL FRAMING: Structural Steel Supports.

C. Section 09 06 00, SCHEDULE FOR FINISHES: Color and Finish of Interior Signs.

D. Division 26, ELECTRICAL Lighted EXIT signs for egress purposes are specified under Electrical Work.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Provide signage that is the product of one manufacturer, who has provided signage as specified for a minimum of three (3) years. Submit manufacturer’s qualifications.

B. Installer’s Qualifications: Minimum three (3) years’ experience in the installation of signage of the type as specified in this Section. Submit installer’s qualifications.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Interior Sign Samples: Sign panels and frames, with letters and symbols, for each sign type.

1. Sign Panel, 203 x 254 mm (8 x 10 inches), with letters.
2. Color samples of each color, 152 x 152 mm (6 x 6 inches. Show anticipated range of color and texture.
3. Sample of typeface, arrow and symbols in a typical full size layout.

D. Exterior Sign Samples: 152 x 152 mm (6 x 6 inches) samples of each color and material.

E. Manufacturer's Literature:

1. Showing the methods and procedures proposed for the anchorage of the signage system to each surface type.

2. Manufacturer's printed specifications and maintenance instructions.

F. Sign Location Plan, showing location, type and total number of signs required.

G. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.

H. Full size layout patterns for dimensional letters.

I. Manufacturer's qualifications.

J. Installer's qualifications.

1.5 DELIVERY AND STORAGE

A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.

C. Deliver signs only when the site and mounting services are ready for installation work to proceed.

D. Store products in dry condition inside enclosed facilities.

1.6 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21, "Warranty of Construction".

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Architectural Manufacturers Association (AAMA):

611-14 ..... Anodized Architectural Aluminum

2603-13 ..... Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

C. American National Standards Institute (ANSI):

A117.1-09..... Accessible and Usable Buildings and Facilities

D. ASTM International (ASTM):

A36/A36M-19 ..... Carbon Structural Steel

A240/A240M-20 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A666-15.....Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

A1011/A1011M-18a.....Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B36/B36M-18.....Brass Plate, Sheet, Strip, and Rolled Bar

B152/B152M-19.....Copper Sheet, Strip, Plate, and Rolled Bar

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate

B209M-14 .....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

B221-14.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

B221M-13 .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)

C1036-16.....Flat Glass

C1048-18.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass

C1349-17.....Architectural Flat Glass Clad Polycarbonate

D1003-13.....Test Method for Haze and Luminous Transmittance of Transparent Plastics

D4802-16.....Poly(Methyl Methacrylate) Acrylic Plastic Sheet

E. Code of Federal Regulation (CFR):

40 CFR 59 .....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

F. Federal Specifications (Fed Spec):

MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.

MIL-P-46144C.....Plastic Sheet, Polycarbonate

G. National Fire Protection Association (NFPA):

70-14 .....National Electrical Code

PART 2 - PRODUCTS

2.1 SIGNAGE GENERAL

A. Provide signs of type, size and design shown on the construction documents.

B. Provide signs complete with lettering, framing and related components for a complete installation.

C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.

D. Do not scale construction documents for dimensions. Verify dimensions and coordinate with field conditions. Notify Contracting Officer Representative (COR) of discrepancies or changes needed to satisfy the requirements of the construction documents.

2.2 EXTERIOR SIGNAGE PERFORMANCE REQUIREMENTS

A. Structural Calculations: Engage a Professional Engineer (PE) who is registered in the state where the work is located to design sign structure and anchorage to withstand design loads.

B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes 67 degrees C (120 degrees F) ambient and 100 degrees C (180 degrees F) material surfaces.

C. Provide installed electrical components and sign installations bearing the label and certifications of Underwriter's Laboratories, Inc., and comply with NFPA 70 as well as applicable federal codes for installation techniques, fabrication methods and general product safety.

2.3 INTERIOR SIGN MATERIALS

A. Aluminum:

1. Sheet and Plate: ASTM B209M (B209).
2. Extrusions and Tubing: ASTM B221M (B221).

B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.

C. Polycarbonate: MIL-P-46144C; Type I, class 1.

D. Vinyl: Premium grade 0.1 mm (0.004 inch) thick machine cut, having a pressure sensitive adhesive and integral colors.

E. Adhesives:

1. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by signage manufacturer.
2. Adhesives to have VOC content of 50 g/L or less when calculated according to 40 CFR 59, (EPA Method 24).

F. Typography: Comply with VA Signage Design Manual.
   1. Type Style: Helvetica Medium and Helvetica Medium Condensed. Initial caps or all caps, as indicated in Sign Message Schedule.
   2. Arrow: Comply with graphic standards in construction documents.
   3. Letter spacing: Comply with graphic standards in construction documents.
   4. Letter spacing: Comply with graphic standards in construction documents.
   5. Provide text, arrows, and symbols in size, colors, typefaces and letter spacing shown in construction documents. Text shall be a true, clean, accurate reproduction of typeface(s). Text shown in construction documents is for layout purposes only; final text for signs is listed in Sign Message Schedule.

2.4 EXTERIOR SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209M (B209).
B. Aluminum Extrusions: ASTM B221M (B221).
C. Brass Sheet (Yellow Brass): ASTM B36/B36M.
D. Bronze Plate: ASTM B36/B36M.
E. Copper Sheet: ASTM B152/B152M.
F. Steel Products: Structural steel products that conform to ASTM A36/A36M. Sheet and strip steel products that conform to ASTM A1011/A1011M.
G. Stainless Steel Sheet: ASTM A240/A240M, stretcher leveled standard of flatness.
H. Acrylic Sheet: ASTM D4802; category as standard with manufacturer for each sign. Provide type UVF.
I. Fiberglass Sheet: Multiple laminations of glass fiber reinforced polyester resin with UV light stabilized, colorfast, nonfading, weather and stain resistant, colored polyester gel coat with manufacturer’s standard finish.
J. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II (coated, mar resistant, UV stabilized polycarbonate) with coating on both sides.
K. Finish:
   1. ALUMINUM FINISHES:
      a. Clear Anodic Finish: AAMA 611.
   2. Metallic Coated Steel Finish:

a. Baked Enamel or Powder Coat Finish: After cleaning and pretreating, apply manufacturer's standard two (2) coat baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 0.05 mm (2 mils).

2.5 INTERIOR SIGN TYPES

A. Conform to the VA Signage Design Manual.

B. Provide insert and frame component system.

C. Component System Signs:

1. Provide interior sign system as follows:

a. Interchangeable system that allows for changes of graphic components of the installed sign, without changing sign in its entirety.

b. Provide sign system comprised of following primary components: Rail Back: Horizontal rails, spaced to allow for uniform, modular sizing of sign types.

1) Rail Insert: Mount to back of Copy Panels to allow for attachment to Rail Back.

2) Copy Panels: Fabricate of acrylic materials to allow for different graphic needs.

3) End Caps: Interlock to Rail Back to enclose and secure changeable Copy Panels.

4) Joiners and Accent Joiners: To connect separate Rail Backs together.

5) Top Accent Bars: To provide decorative trim cap that encloses the top of sign.

c. Provide rail back, rail insert and end caps in anodized extruded aluminum.

d. Provide signs in system that are convertible in the field to allow for enlargement from one (1) size to another in height and width through use of joiners or accent joiners, which connect rail back panels together blindly, providing a butt joint between copy panels. Connect accent joiners to rail backs with a visible 3 mm (1/8") horizontal rib, flush to the adjacent copy insert surfaces.

e. Provide sign configurations as indicated on construction documents that vary in width from 228 mm (9 inches) to 2032 mm (80 inches), and have height dimensions of 50 mm (2 inches), 76 mm (3 inches), 152 mm (6 inches), 228 mm (9 inches) and 305 mm (12 inches). Height that can be increased beyond 305 mm (12 inches), by repeating height module in full or in part.

2. Provide rail back functions as internal structural member of sign. Fabricate of 6063T5-extruded aluminum, anodized black.

a. Fabricate to accept an extruded aluminum or plastic insert on either side, depending upon sign type.

b. Provide components that are convertible in field to allow for connection to other rail back panels.

c. Provide mounting devices including wall mounting for screw-on applications and other mounting devices as needed.

3. Provide rail insert functions as mounting device for copy panels on to the rail back. The rail insert mounts to the back of the copy panel with adhesive suitable for attaching particular copy insert material.

   a. Provide copy panels that slide or snap into the horizontal rail back.

4. Provide copy panels that accept various forms of copy and graphics, and attach to the rail back with the rail insert. Provide copy panels fabricated of ABS plastic with integral color or an acrylic lacquer finish acrylic .

   a. Provide copy panels that are interchangeable by sliding horizontally from either side of sign, and to other signs in system of equal or greater width or height.

   b. Provide materials that are cleanable without use of special chemicals or cleaning solutions.

   c. Copy Panel Materials.

      1) ABS Inserts: 2.3 mm (.090 inches) extruded ABS plastic core with .07 mm (.003 inches) acrylic cap bonded during extrusion/texturing process.

         a) Pressure bonded to extruded rail insert with adhesive.

         b) Background Color: Integral or painted in acrylic lacquer.

         c) Finished: Texture pattern.

      2) Photopolymer Inserts: 3.2 mm (.125 inches) phenolic photo polymer with raised copy etched to 2.3 mm (.0937 inches), bonded to an ABS plastic or extruded aluminum insert with adhesive.

         a) a) Background Color: Painted, acrylic enamel.

      3) Changeable Paper/ Insert Holder: Extruded insert holder with integral rail insert for connection with structural back panel in 6063T5 aluminum with a black anodized finish.

         a) Inserts into holder are paper with a clear 0.76 mm (.030 inches) textured cover.

         b) Background Color: Painted, acrylic lacquer.

      4) Acrylic - 2 mm (.080 inches) non-glare acrylic.

         a) Pressure bonded to extruded rail insert using adhesive.

b) Background Color: Painted in acrylic lacquer or acrylic enamel.

5) Extruded 6063T5 aluminum with a black anodized finish insert holder with integral rail insert for connection with structural back panel to hold 0.76 mm (.030 inches) textured polycarbonate insert and a sliding tile which mounts in the inset holder and slides horizontally.

5. End Caps: Extruded using 6063T5 aluminum with a black anodized finish. End caps interlock with rail back with clips to form an integral unit, enclosing and securing the changeable copy panels, without requiring tools for assembly.
   a. Interchangeable to each end of sign and to other signs in signage system of equal height.
   b. Provide mechanical fasteners that can be added to the end caps that will secure it to rail back to make sign tamper resistant.
6. Joiners: Extruded using 6063T5 aluminum with a black anodized finish. Rail joiners connect rail backs together blindly, providing a butt joint between copy inserts.
7. Accent Joiners: Extruded using 6063T5 aluminum with a mirror polished finish. Connect joiner and rail backs together with a visible 3 mm (.125 inches) horizontal rib, flush to the adjacent copy panel surfaces.
8. Top Accent Rail: Extruded rail using 6063T5 aluminum with a mirror polished finish that provides a 3.2 mm (.125 inches) high decorative trim cap. Cap butts flush to adjacent copy panel and encloses top of rail back and copy panel.
9. Typography:
   a. Vinyl First Surface Copy (non-tactile): Applied vinyl copy.
   b. Subsurface Copy Inserts: Textured 1 mm (.030 inches) clear polycarbonate face with subsurface applied vinyl copy.
      1) Spray face back with paint and laminated to extruded aluminum carrier insert.
   c. Integral Tactile Copy Inserts: Phenolic photopolymer etched with 2.3 mm (.0937 inches) raised copy.
   d. Silk-screened First Surface Copy (non-tactile): Injection molded or extruded ABS plastic insert with first surface applied enamel silk-screened copy.

D. Tactile Sign:

1. Tactile sign made from a material that provides for letters, numbers and Braille to be integral with sign. Photopolymer etched metal, sandblasted phenolic or embossed material. Do not apply letters, numbers and Braille with adhesive.
2. Numbers, letters and Braille to be raised 0.8 mm (1/32 inches) from the background surface. The draft of the letters, numbers and Braille to be tapered, vertical and clean.
3. Braille Dots: Conform with ANSI A117.1 for Braille position and layout; (a) Dot base diameter: 1.5 mm (.059 inches) (b) Inter-dot spacing: 2.3 mm (.090 inches) (c) Horizontal separation between cells: 6.0 mm (.241 inches) (d) Vertical separation between cells: 10.0 mm (.395 inches)
4. Paint assembly specified color. After painting, apply white or other specified color to surface of the numbers and letters. Apply protective clear coat sealant to entire sign.
5. Finish: Eggshell, 11 to 19 degree on a 60 degree glossmeter.

E. Provide cork or felt on bottom or mounting bracket when sign is mounted on counter or desk.

F. For ceiling mounted signs, provide mounting hardware on the sign that allows for sign disconnection, removal, reinstallation, and reconnection.

G. Dimensional Letters:
1. Provide dimensional letters that are mill or laser cut acrylic in size and thickness indicated in construction documents.
2. Provide draft of letters perpendicular to letters face.
3. Fabricate letters with square corners, such as where a letter stem and bar intersect.
4. Paint letters with acrylic polyurethane.

H. Temporary Interior Signs:
1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 101 mm (4 inch) wide by 305 mm (12 inch) long.
   a. Punched 3.2 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 101 mm (4 inch) side.
   b. Reinforce hole on both sides with suitable material that prevents tie from pulling through hole.
   c. Ties: Steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 152 mm (6 inch) long free ends.
2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on construction documents.

3. Install temporary signs to rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
    a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.
    b. Replace and missing, damaged or illegible signs.

2.6 EXTERIOR SIGN TYPES

A. General:
    1. Fabricate signs that comply with VA Signage Design Manual.
B. Text and Graphics:
    1. Non-illuminated Signs: Provide surface applied reflective white opaque vinyl graphics.

2.7 FABRICATION

A. Design interior signage components to allow for expansion and contraction for a minimum material temperature range of 38 degrees C (100 degrees F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Provide concealed fasteners wherever possible.
C. Shop fabricate so far as practicable. Fasten joints flush to conceal reinforcement, or weld joints, where thickness or section permits.
D. Level and assemble contract surfaces of connected members so joints will be tight and practically unnoticeable, without applying filling compound.
E. Signs: Fabricate with fine, even texture to be flat and sound.
    1. Maintain lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern.
    2. Plane surfaces to be smooth, flat and without oil-canning, free of rack and twist.
    3. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
F. Finish extruded members to be free from extrusion marks. Fabricate square turns, sharp corners, and true curves.
G. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Miter edge joints to give appearance of solid material.

H. Do not manufacture signs until final sign message schedule and location review has been completed by the COR and forwarded to contractor.

I. Drill holes for bolts and screws. Mill smooth exposed ends and edges with corners slightly rounded.

J. Form joints exposed to weather to exclude water.

K. Movable Parts, Including Hardware: Cleaned and adjusted to operate as designed without binding or deformation of members. Center doors and covers in opening or frame.

   1. Align contact surfaces fit tight and even without forcing or warping components.

L. Pre-assemble items in shop to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

M. Prime painted surfaces as required. Apply finish coating of paint for complete coverage with no light or thin applications allowing substrate or primer to show.

   1. Finish surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate signs as shown on the construction documents .

B. Where not otherwise indicated conform to the VA Signage Design Manual for installation requirements.

C. At each sign location there are no utility lines behind each sign location that will be affected by installation of signs.

   1. Correct and repair damage done to utilities during installation of signs at no additional cost to Government.

D. Provide inserts and anchoring devices which must be set in concrete or other material for installation of signs. Submit setting drawings, templates, instructions and directions for installation of anchorage devices, which may involve other trades.

E. Refer to Sign Message Schedule for mounting method. Mount signs in proper alignment, level and plumb according to the Sign Location Plan and the dimensions given on elevation and Sign Location Plans. When exact position, angle, height or location is not clear, contact COR for resolution.

F. When signs are installed on glass, provide blank glass back up to be placed on opposite side of glass exactly behind sign being installed. Provide blank glass back that is the same size as sign being installed.

G. Touch up exposed fasteners and connecting hardware to match color and finish of surrounding surface.

H. At completion of sign installation, clean exposed sign surfaces. Clean and repair adjoining or adjacent surfaces that became soiled or damaged as a result of installation of signs.

- - - END - - -

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies wall guards, handrail/wall guard combinations, corner guards and door/door frame protectors.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 08 71 00, DOOR HARDWARE: Armor plates and kick plates not specified in this section.

C. Section 09 06 00, SCHEDULE FOR FINISHES: Color and texture of aluminum and resilient material.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Manufacturer with a minimum of three (3) years’ experience in providing items of type specified.

1. Obtain wall and door protection from single manufacturer.

B. Installer’s Qualifications: Installers are to have a minimum of three (3) years’ experience in the installation of units required for this project.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. 1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
2. For composite wood products, submit documentation indicating product contains no added urea formaldehyde.

C. Shop Drawings: show design and installation details.

D. Manufacturer's Literature and Data:

1. Handrail/Wall Guard Combinations.
2. Wall Guards.
3. Corner Guards.
4. Door/Door Frame Protectors.

E. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

F. Manufacturer’s qualifications.

G. Installer's qualifications.

H. Manufacturer's warranty.

1.5 DELIVERY AND STORAGE

A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.

B. Protect from damage from handling and construction operations before, during and after installation.

C. Store in a dry environment of approximately 21 degrees C (70 degrees F) for at least 48 hours prior to installation.

1.6 WARRANTY

A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".

B. Manufacturer Warranty: Manufacturer shall warranty their wall and door protection for a minimum of five (5) years from date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.7 APPLICABLE PUBLICATIONS

A. publications listed below form a part of this specification to extent referenced. publications are referenced in text by basic designation only.

B. ASTM International (ASTM):

A240/A240M-20 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and For General Applications

B221-14 ..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B221M-13 ..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

D256-10(2018) ..... Determining the Izod Pendulum Impact Resistance of Plastics

D635-18..... Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

E84-20 ..... Surface Burning Characteristics of Building Materials

C. Aluminum Association (AA):

DAF 45-09..... Designation System for Aluminum Finishes

D. American Architectural Manufacturers Association (AAMA):

611-14 ..... Voluntary Specification for Anodized Architectural Aluminum

E. Code of Federal Regulation (CFR):

40 CFR 59(2020) Subpart D..... National Volatile Organic Compound Emission Standards for Architectural Coatings

F. The National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06 .....Metal Finishes Manual

G. National Fire Protection Association (NFPA):

80-2019 .....Standard for Fire Doors and Other Opening Protectives

H. SAE International (SAE):

J 1545-2014-10.....Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim.

I. Underwriters Laboratories Inc. (UL):

Annual Issue.....Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: A240/A240M, Type 304.

B. Aluminum Extruded: ASTM B221M (B221), Alloy 6063, Temper T5 or T6.

C. Resilient Material:

1. Provide resilient material consisting of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic conforming to the following:
   a. Minimum impact resistance of 960.8 N-m/m (18 feet-pounds/square inch) when tested in accordance with ASTM D256 (Izod impact, feet-pounds per inch notched).
   b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.
   c. Rated self-extinguishing when tested in accordance with ASTM D635.
   d. Provide material labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
   e. Provide resilient material for protection on fire rated doors and frames assemblies that is listed by the testing laboratory performing the tests.
   f. Provide resilient material installed on fire rated wood/steel door and frame assemblies that have been tested on similar type assemblies. Test results of material tested on any other combination of door and frame assembly are not acceptable.

g. Provide integral color with colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.2 CORNER GUARDS

A. Resilient, Shock-Absorbing Corner Guards: Surface mounted type.

1. snap-on corner guard formed from resilient material, minimum 1.98 mm (0.078-inch) thick, free floating on a continuous 1.52 mm (0.060-inch) thick extruded aluminum retainer. Provide appropriate mounting hardware, cushions and base plates as required.
2. Profile: Minimum 50 mm (2 inch) long leg and 6 mm (1/4 inch) corner radius.
3. Height: 1.22 m (4 feet).
4. Retainer Clips: Provide manufacturer's standard impact-absorbing clips.
5. Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.
6. Flush mounted corner guards installed on any fire rated wall to be installed in a manner that maintains the fire rating of the wall. Provide fire test of proposed corner guard system to verify compliance.
   a. Where insulating materials are an integral part of the corner guard system, provide insulating materials furnished by the manufacturer of the corner guard system.

2.3 WALL GUARDS AND HANDRAILS

A. Resilient Wall Guards and Handrails:

1. Handrail/Wall Guard Combination:
   a. Snap-on covers of resilient material, minimum 2 mm (0.078-inch) thick.
   b. Free-floating on a continuous, extruded aluminum retainer, minimum 1.82 mm (0.072-inch) thick.
   c. Anchor to wall at maximum 762 mm (30 inches) on center.
2. Wall Guards:
   a. Snap-on covers of resilient material, minimum 2.54 mm (0.100-inch) thick. Free-floating over 51 mm (2 inch) wide aluminum retainer clips, minimum 2.28 mm (0.090-inch) thick, anchored to wall at maximum 610 mm (24 inches) on center, supporting a continuous aluminum retainer, minimum 1.57 mm (0.062-inch) thick.
3. Provide handrails and wall guards with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required.

End caps and corners to be field adjustable to assure close alignment with handrails and wall guards. Screw or bolt closure caps to aluminum retainer in a concealed manner.

B. Aluminum Wall Guards: Extruded aluminum, closed tubular bumper assembly mounted on wall brackets.
   1. Provide wall bumper with factory fabricated end closure caps, and inside and outside corner assemblies, concealed splice plates, and other accessories standard with the manufacturer.
   2. Fabricate tubular wall guards from material with a nominal wall thickness of 6.35 mm (0.250-inch), form grooves for and provide two (2) strips of continuous polyvinyl chloride cushion bumper inserts.
   3. Fabricate adjustable wall brackets from aluminum having a nominal wall thickness of 5.08 mm (0.20-inch). Fasten bumper to brackets with 6.35 mm (1/4-inch) diameter aluminum or stainless steel bolts with locknuts.

C. Stainless Steel Wall Guards: Construct wall guard, including brackets, of minimum 4.76 mm (0.1875-inch) thick stainless steel.

2.4 DOOR AND DOOR FRAME PROTECTION

A. Fabricate door and door frame protection items from vinyl acrylic or polyvinyl chloride resilient material, minimum 1.52 mm (0.060-inch) thick, for doors and 0.89 mm (0.035-inch) thick for door frames.

B. Provide adhesive as recommended by resilient material manufacturer.

2.5 FASTENERS AND ANCHORS

A. Provide fasteners and anchors as required for each specific type of installation.

B. Where type, size, spacing or method of fastening is not shown or specified in construction documents, submit shop drawings showing proposed installation details.

2.6 FINISH

A. Aluminum: In accordance with AA DAF-45.
   1. Exposed aluminum: AAMA 611 AA-M12C22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, .01 mm (0.4 mil) thick.
   2. Concealed aluminum: Mill finish as fabricated, uniform in color and free from surface blemishes.

B. Stainless Steel: In accordance with NAAMM AMP 500 finish Number 4.

C. Resilient Material: Embossed textures and color in accordance with SAE J1545.

PART 3 - INSTALLATION

3.1 RESILIENT CORNER GUARDS

A. Install corner guards on walls in accordance with manufacturer's instructions.

3.2 RESILIENT WALL GUARDS

A. Secure guards to walls with mounting cushions and fasteners in accordance with manufacturer's details and instructions.

3.3 ALUMINUM WALL GUARDS

A. Secure brackets to walls with fasteners, spaced in accordance with manufacturer's installation instructions.

3.4 STAINLESS STEEL WALL GUARDS

A. Space brackets at not more than 914 mm (3 feet) on centers and anchor to the wall in accordance with manufacturer's installation instructions.

3.5 DOOR, DOOR FRAME PROTECTION AND HIGH IMPACT WALL COVERING

A. Surfaces to receive protection to be clean, smooth and free of obstructions.

B. Install protectors after frames are in place but preceding installation of doors in accordance with approved shop drawings and manufacturer’s specific instructions.

C. Apply with adhesive in controlled environment according to manufacturer’s recommendations.

D. Protection installed on fire rated doors and frames to be installed according to NFPA 80 and installation procedures listed in UL Building Materials Directory; or, equal listing by other approved independent testing laboratory establishing the procedures.

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SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

This section covers recessed fire extinguisher cabinets.

1.2 RELATED WORK

A. Field Painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

1.4 APPLICATION PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Testing and Materials (ASTM):

D4802-15.....Poly (Methyl Methacrylate) Acrylic Plastic Sheet

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINET

A. Recessed type with flat trim of size and design shown.

2.2 FABRICATION

A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.

B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.

1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish.
2. Design doors to open 180 degrees.
3. Provide continuous hinge, pull handle, and adjustable roller catch.

2.3 FINISH

A. Finish interior of cabinet body with baked-on semigloss white enamel.

B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

PART 3 - EXECUTION

A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.

B. Install cabinet so that the extinguisher height within meets the requirements of NFPA 10

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SECTION 13 05 41
SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Provide seismic restraint in accordance with the requirements of the drawings, VA Handbook H18-8: Seismic Design Requirements and this specification in order to maintain the integrity of non-structural components and equipment of the building so that they remain safe and functional in case of seismic event.

B. The design of seismic restraints of non-structural components to resist seismic load shall be based on Seismic Design parameters indicated below in accordance with VA H-18-8 in conjunction with ASCE 7, as specified in H-18-8 Section 4.0, for existing building retrofit projects. Specific requirements for Critical and Essential facilities are covered in Section 4.0 of H-18-8, including applying Ip = 1.5 for all nonstructural components in Critical facilities.

1. International Building Code 2021 Edition
2. American Society of Civil Engineers Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7) 7-16
3. Facility Occupancy Category per VA H-18-8: Critical
4. Site Class: C
5. Building Risk Category: IV
6. Mapped MCE_R 0.2 s period Spectral Response Acceleration Parameter (Ss): .26
7. Mapped MCE_R 1.0 s period Spectral Response Acceleration Parameter (S1): 0.062
8. Short period Spectral Response Acceleration Parameter (Sds):0.21
9. Short period Spectral Response Acceleration Parameter (Sd1): 0.087
10. Building Seismic Design Category: C
11. Components Importance Factor 1.5
12. Components Response Modification Factors (Rp): Varies
13. Components Overstrength Factors: varies

C. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include but are not limited to (Refer to VA H-18-8, ASCE 7 and ASCE 41 for additional examples):

1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks, etc.
2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems, etc.
3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler/chiller/utility plant/other equipment and components, etc.
4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 RELATED WORK:

Related specifications include but are not limited to those shown below. Coordinate all work with the applicable specification for that work.

A. Structural Steel Framing: Section 05 12 00, STRUCTURAL STEEL FRAMING
B. Interior Lighting: Section 26 51 00, INTERIOR LIGHTING

1.3 QUALITY CONTROL:

A. Shop-Drawing Preparation:
   1. Non-structural seismic restraint systems shop drawings and delegated design calculations shall be prepared by a professional structural engineer with a minimum of 5 years' experience in the design and detailing of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located and submit qualifications with list of projects illustrating compliance with the experience requirement of this section.
   2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.
B. Coordination:
   1. Do not install seismic restraints until seismic restraint submittals are approved by the Contracting Officers Representative (COR).

2. Coordinate trapezes or other multi-pipe hanger systems prior to submission of shop drawings for review.

C. Seismic Certification:

In structures assigned to Seismic Design Category C, D, E, or F, permanent equipment and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7, including those required in existing buildings within Section 13.7.1.3.3, 13.7.7.3.3 and 13.7.8.3.3 of ASCE 41, except for equipment and components that are considered inherently rugged as listed in Section 4.2.2 of VA H18-8, and shall comply with section 13.2.6 of ASCE 7.

1.4 SUBMITTALS:

A. Submit a complete and coordinated set of bracing and signed and sealed anchorage drawings and calculations for all non-structural elements requiring seismic restraint by the delegated professional structural engineer mentioned in Section 1.3.A.1 for review prior to installation including:

1. Description, layout, and location of all items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of all anchorage and bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified. Details shall be coordinated with all project conditions and trades prior to shop drawing submission for review.
3. Complete calculations including but not limited to seismic design criteria, computer model input and output, seismic design forces and capacities, design tables and information used for all proprietary design elements such as post installed anchors, stamped and signed by a professional structural engineer specified in section 1.3 A.1.
4. For all post installed anchorages submit the appropriate International Code Council Engineering Service (ICC-ES) evaluation reports, California's Office of Statewide Health Planning and Development(OSHPD) pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.
5. Delegated professional structural engineer qualifications.

B. Submit for review prior to installation, the following for seismic protection of piping in addition to items noted in Section 1.4.A:

1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
3. Pipe contents.
4. Structural framing for the seismic and gravity support and the main superstructure for which the bracing and or anchorage is attached.
5. Location of all gravity load pipe supports and spacing requirements.
6. Numerical value of gravity load reactions.
7. Location of all seismic bracing.
8. Numerical value of applied seismic brace loads.
9. Type of connection (Vertical support, vertical support with seismic brace etc.).
10. Seismic brace reaction type (tension or compression): Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.

C. Submit for review prior to installation, the following items for seismic protection of suspended ductwork and suspended electrical and communication cables, in addition to items noted in Section 1.4.A:
   1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
   2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
   3. Maximum spacing of hangers and bracing.

1.5 APPLICABLE PUBLICATIONS:

A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):
   355.2-19 ..... Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary

C. American Institute of Steel Construction (AISC):
   Load and Resistance Factor Design, Volume 1, Second Edition

D. ASTM International (ASTM):

A36/A36M-19 .....Standard Specification for Carbon Structural Steel

A53/A53M-18 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A307-14e1.....Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A325-14.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A325M-14 .....Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]

A490-14a.....Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

A490M-14a .....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]

A500/A500M-18 .....Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

A501/A501M-14 .....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

A615/A615M-20 .....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A992/A992M-11(2015).....Standard Specification for Steel for Structural Shapes for Use in Building Framing

A996/A996M-16 .....Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement

E488/E488M-18 .....Standard Test Methods for Strength of Anchors in Concrete Elements

E. American Society of Civil Engineers

1. Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7) Edition as indicated in section 1.1 B of this specification. Associated Criteria for Buildings and Other Structures (ASCE 7): 7-16

F. International Building Code (IBC) Edition as indicated in Section 1.1 B of this specification.

G. VA Handbook H18-8 Seismic Design Requirements, VA H-18-8, November 2019(REVISED MAY 1,2020)
H. National Uniform Seismic Installation Guidelines (NUSIG)
I. Sheet Metal and Air Conditioning Contractors National Association
J. (SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems, 3RD EDITION 2008 and Addendum

1.6 REGULATORY REQUIREMENT:

A. IBC as shown in Section 1.1 B of this specification.
B. Exceptions: The omission of seismic restraints shall be allowed only in accordance with VA H18-8, ASCE 7 .

PART 2 - PRODUCTS

2.1 STEEL:

A. Structural Steel: ASTM A36 A992.
B. Structural Tubing: ASTM A500, Grade B.
C. Structural Tubing: ASTM A501.
D. Steel Pipe: ASTM A53/A53M, Grade B.
E. Bolts & Nuts: ASTM A307

2.2 CAST-IN-PLACE CONCRETE:

A. Concrete: 28 day strength, f'c = per approved drawings
B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
C. Construct seismic restraints and anchorage to allow for thermal expansion.
D. Testing Before Final Inspection:
    1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the

required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.

2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.
3. Construct seismic restraints and anchorages to not interfere with other trades or damage existing or in-situ elements of the constructed building.

3.2 EQUIPMENT RESTRAINT AND BRACING:

A. See drawings for equipment to be restrained or braced.

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
B. Brace duct and breeching branches with a minimum of 1 brace per branch.
C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
D. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 PARTITIONS

A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.
B. Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.

3.5 CEILINGS AND LIGHTING FIXTURES

A. At intervals required to meet the seismic demand forces, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.
B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

3.6 FACADES AND GLAZING

A. Do not install concrete masonry unit filler walls in a manner that can restrain the lateral deflection of the building frame. Provide a gap with adequately sized resilient filler to separate the structural frame from the non-structural filler wall.

B. Tie brick veneers to a separate wall that is independent of the steel frame as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

C. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

3.7 STORAGE RACKS, CABINETS, AND BOOKCASES

A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.

B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.

C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.

D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

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SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Design, installation and testing shall be in accordance with NFPA 13.

B. The design and installation of a hydraulically calculated automatic wet-pipe system complete and ready for operation, for all portions of the new Data Center Room. Phased installation shall be in line with phasing shown in Mechanical design drawings.

C. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Section 07 84 00, FIRESTOPPING.

C. Section 09 91 00, PAINTING.

D. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.

E. Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 DESIGN CRITERIA

A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.

1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.

2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:

   a. Light Hazard Occupancies: Walkways, and Telecommunication Rooms.

   b. Ordinary Hazard Group 1 Occupancies: Data Center, , Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, and Electric Closets.

   c. Ordinary Hazard Group 2 Occupancies: Storage rooms.

3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
4. Water Supply: Base water supply on a flow test of:
   a. Location: ____VA Hospital 215 North Main Street White River Junction, VT 05001 test location #1 Per RFI response document.
   b. Static pressure: ___75___ psi
   c. Residual pressure: ___65___ psi
   d. Flow: ___524___ gpm
   e. Date: __7/12/2022____
5. Zoning:
   a. For each sprinkler zone provide a control valve, flow switch, and a test and drain assembly with pressure gauge. For buildings greater than two stories, provide a check valve at each control valve.
   b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.
6. Provide seismic protection in accordance with NFPA 13. Contractor shall submit load calculations for sizing of sway bracing for systems that are required to be protected against damage from earthquakes.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format or as directed by the COR. Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors fire sprinkler and Vermont contractor's license.

b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.

c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size. Include a plan showing the piping to the water supply test location.

3. Manufacturer's Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.

4. Calculation Sheets:

a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.

b. Submit calculations of loads for sizing of sway bracing in accordance with NFPA 13.

5. Valve Charts: Provide a valve chart that identifies the location of each control valve. Coordinate nomenclature and identification of control valves with COR. Where existing nomenclature does not exist, the chart shall include no less than the following: Tag ID No., Valve Size, Service (control valve, main drain, aux. drain, inspectors test valve, etc.), and Location.

6. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:

a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below via electronic file transfer site or as directed by the COR.

1) One full size (or size as directed by the COR) printed copy.
2) One complete set in electronic pdf format.
3) One complete set in AutoCAD format or a format as directed by the COR.

b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.

c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.

d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format as directed by the COR.

e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

1.5 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Vermont fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.

B. Materials and Equipment: All equipment and devices shall be of a make and type approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA. All materials and equipment shall be free from defect. All materials and equipment shall be new unless specifically indicated otherwise on the contract drawings.

1.6 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions at the time of construction of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

13-13 .....Installation of Sprinkler Systems

25-14 .....Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

101-15 .....Life Safety Code

170-15 .....Fire Safety Symbols

C. Factory Mutual Engineering Corporation (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 PIPING & FITTINGS

A. Piping and fittings for private underground water mains shall be in accordance with NFPA 13.

1. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: Ductile Iron, flanged fittings and 316 stainless steel bolting.

B. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.

1. Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
2. Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
3. Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.
4. Plastic piping shall not be permitted except for drain piping.
5. Flexible sprinkler hose shall be FM Approved and limited to hose with threaded end fittings with a minimum inside diameter or 1-inch and a maximum length of 6-feet.

2.2 VALVES

A. General:

1. Valves shall be in accordance with NFPA 13.
2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.

B. Control Valve: The control valves shall be a listed indicating type. Control valves shall be UL Listed or FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.

C. Check Valve: Shall be of the swing type with a flanged cast iron body and flanged inspection plate.

D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

E. Alarm Check Valve: Alarm check valve shall be UL Listed and Factory Mutual Approved. The alarm check valve shall be listed for installation in the vertical or horizontal position. The alarm check valve shall be equipped with a removable cover assembly, gauge connections on the system side and supply side of the valve clapper, variable pressure trim, and an external bypass to eliminate false water flow alarms. The alarm check valve trim piping shall be galvanized. Maximum water working pressure to 250 PSI.

F. Backflow Preventer: Provide backflow preventer in accordance with Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING. Provide means to forward flow test the backflow preventer in accordance with NFPA 13.

2.3 SPRINKLERS

A. Provide FM approved quick response sprinklers in all areas, except that standard response sprinklers shall be provided in Telecommunication Rooms and Data Centers.

B.

C. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler. For Telecommunication rooms and Data Centers, provide sprinklers with protective guard cages.

2.4 **SPRINKLER CABINET**

A. Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each type of sprinkler in accordance with NFPA 13. Locate adjacent to the riser.

B. Provide a list of sprinklers installed in the property in the cabinet. The list shall include the following:

1. Manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure for each type of sprinkler in the cabinet.
2. General description of where each sprinkler is used.
3. Quantity of each type present in the cabinet.
4. Issue or revision date of list.

2.5 SPRINKLER SYSTEM SIGNAGE

Rigid plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Sprinkler system signage shall be attached to the valve or piping with chain.

2.6 SWITCHES:

A. OS&Y Valve Supervisory Switches shall be in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.

B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.

C. Alarm Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. The alarm pressure switch shall be UL Listed or Factory Mutual Approved for the application in which it is used. Activation of the alarm pressure switch shall cause an alarm on the fire alarm system control unit.

D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.7 GAUGES

Provide gauges as required by NFPA 13. Provide gauges where the normal pressure of the system is at the midrange of the gauge.

2.8 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING

Pipe hangers, supports, and restraint of system piping shall be in accordance with NFPA 13.

2.9 WALL, FLOOR AND CEILING PLATES

Provide chrome plated steel escutcheon plates.

2.10 VALVE TAGS

Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook, brass chain, or nylon twist tie.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Piping shall not obstruct the minimum means of egress clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping, and seismic bracing shall be installed accordance with NFPA 13.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

F. Waterflow Alarm Switches: Install waterflow alarm switches and valves in stairwells or other easily accessible locations.

G. Inspector's Test Connection: Install and supply in accordance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.

H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

I. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.

J. Clearances: For systems requiring seismic protection, piping that passes through floors or walls shall have penetrations sized 50 mm (2 inches) nominally larger than the penetrating pipe for pipe sizes 25 mm (1 inch) to 90 mm (3 ½ inches) and 100 mm (4 inches) nominally larger for penetrating pipe sizes 100 mm (4 inches) and larger.

K. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core

drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.

L. Provide pressure gauges at each water flow alarm switch location and at each main drain connection.

M. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).

N. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

O. Painting of Pipe: In finished areas where walls and ceilings have been painted, paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Exercise care to avoid painting sprinklers. Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Painting shall comply with Section 09 91 00, PAINTING. Any painted sprinkler shall be replaced with a new sprinkler.

P. Sprinkler System Signage: Provide rigid sprinkler system signage in accordance with NFPA 13 and NFPA 25. Sprinkler system signage shall include, but not limited to, the following:

1. Identification Signs:
   a. Provide signage for each control valve, drain valve, sprinkler cabinet, and inspector's test.
   b. Provide valve tags for each operable valve. Coordinate nomenclature and identification of operable valves with COR. Where existing nomenclature does not exist, the Tag Identification shall include no less than the following: (FP-B-F/SZ-#) Fire Protection, Building Number, Floor Number/Smoke Zone (if applicable), and Valve Number. (E.g., FP-500-1E-001) Fire Protection, Building 500, First Floor East, Number 001.)
2. Instruction/Information Signs:
   a. Provide signage for each control valve to indicate valve function and to indicate what system is being controlled.
   b. Provide signage indicating the number and location of low point drains.
3. Hydraulic Placards:
   a. Provide signage indicating hydraulic design information. The placard shall include location of the design area, discharge densities, required flow and residual pressure at

the base of riser, occupancy classification, hose stream allowance, flow test information, and installing contractor. Locate hydraulic placard information signs at each alarm check valve.

Q. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.

R. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Representative (COR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.3 INSTRUCTIONS

Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COR.

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SECTION 21 22 00
CLEAN AGENT FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Design, installation and testing of a calculated automatic and manual fixed total flooding clean agent fire extinguishing system and releasing system in accordance with NFPA 2001, NFPA 72, NFPA 70, and NFPA 75 and manufacturer's written instructions for the locations shown on the contract drawings. The installation shall include all mechanical, controls and electrical components necessary for a complete and operating clean agent fire suppression system.

B. Design and install the clean agent system in a manner to ensure cold aisle containment systems do not obstruct the free flow of gaseous clean agent suppression systems to the ITE or cooling system serving the contained aisle within the Data Center.

C. Smoke detection for the clean agent system initiation shall be installed to ensure detectors are installed no more than one half the listed spacing and not to exceed a coverage area of 250 sq ft per detector.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

B. Section 07 84 00, FIRESTOPPING

C. Section 09 91 00, PAINTING

D. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

E. Section 28 05 28.33, CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

F. Section 28 31 00, FIRE DETECTION AND ALARM

1.3 DESIGN CRITERIA

A. The clean agent fire extinguishing system shall be a fixed total flooding type utilizing clean agent designed to provide a uniform concentration throughout the protected spaces in accordance with NFPA 2001 for a Class C fire.

1. The system shall provide a minimum design concentration by volume, throughout the protected spaces at the minimum anticipated temperature within the protected space.
2. The design concentration within any protected space shall not exceed by volume the no observable adverse effects level (NOAEL). Special means such as mechanical exhaust, shall not be permitted to be used to achieve this criterion.

3. The clean agent shall have a global warming potential (GWP) of less than 4000 and the clean agent shall be readily available throughout the continental United States.
4. Provide the quantity of clean agent as required by NFPA 2001 and manufacturer's written instructions. Such factors as unenclosed openings (if any), "rundown" time of fans, time required for dampers to close, and any other feature of the facility that could affect concentration shall be taken into consideration.
5. Phased installation shall be in line with phasing shown in Mechanical design drawings.

1.4 SUBMITTALS

A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level IV Special Hazards Suppression Systems Technician. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4 (A) 1 through 1.4 (A) 5 electronically in pdf format via approved file transfer siteor as directed by the Contracting Officers Representative (COR). Submittals shall include, but not be limited to, the following:

1. Qualifications:
   a. Provide a copy of the installing contractors and state contractors license.
   b. Provide a copy of the NICET certification for the NICET Level IV Special Hazards Suppression System Technician who will prepare and sign the detailed working drawings.
   c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of clean agent fire suppression systems for the past ten years.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working plans and drawings of the clean agent fire extinguishing system conforming to NFPA 2001. Submit detailed 1:100 (1/8 inch) scale (minimum) working plans and drawings of the releasing system conforming to NFPA 72. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size.

3. Manufacturers Data Sheets:
   a. Provide for all materials and equipment proposed for use on the clean agent fire extinguishing system, including the releasing system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets:
   a. Submit flow calculation sheets in tabular form conforming to the requirements of NFPA 2001. Calculations shall include total storage capacity, flooding concentrations, enclosure leakage rates, discharge times, flow through distribution network, pipe sizes, and nozzle orifice sizes.
   b. Submit battery calculations sheets in tabular form conforming to the requirements of NFPA 72.
   c. Submit voltage drop calculations in tabular form. Calculations shall indicate circuit amperage draw, wire resistance, circuit length, and voltage drop. The voltage drop shall demonstrate that voltage provided at the each appliance is within its operating voltage range. Voltage drop calculations shall assume an initial voltage of 20.4 volts.
5. Clean Agent Recharging Certification: Provide a letter to the COR or his designated representative certifying that the installer maintains or has access to a clean agent recharging station. The installer shall also provide proof of the ability to recharge the largest clean agent fire extinguishing system capacity within 48 hours.
6. Test Plan: Provide a test plan to the COR or his designated representative. The testing plan shall describe the procedures to be used to test the system. The testing plan shall include a step-by-step procedure of all tests to be performed, including indication of which tests will present a disruption to building occupants. No tests shall be conducted until the testing plan is approved by the COR or his designated representative.
7. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Submittals shall include, but not be limited to, the following:
   a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below via an approved electronic file transfer siteor as directed by the COR.

1) One full size (or size as directed by the COR) printed copy.
2) One complete set in electronic pdf format.
3) One complete set in AutoCAD format or a format as directed by the COR.

b. System Certification: Upon completion of the clean agent fire extinguishing system installation, including testing, the authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved. Provide a copy of the Record of Completion for the releasing system in accordance with NFPA 72.

c. Operating and Maintenance Manuals that include step-by-step procedures required for operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, the name of the local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.

d. One paper copy of the System Certification and Record of Completion and the Operating and Maintenance Manuals listed above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.

e. Provide one additional copy of the Operations and Maintenance Manual for the system in a binder and mount in an accessible location adjacent to the storage cylinder(s).

1.5 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid State of Vermont contractor's license. The installer shall have been actively and successfully engaged in the installation of clean agent special suppression systems for the past ten years. The installer shall maintain or have access to a clean agent recharging station. The installer shall provide proof of the ability to recharge the largest clean agent fire extinguishing system capacity within 48 hours.

B. Materials and Equipment: All equipment and devices shall be UL listed or approved by FM. All materials, devices, and equipment shall be approved by the VA. All materials and equipment shall be free from defect.

1.6 APPLICABLE PUIBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

70- .....National Electric Code

72- .....National Fire Alarm Code

75- .....Fire Protection of Information Technology Equipment

170- .....Fire Safety Symbols

2001- .....Installation of Clean Agent Fire Extinguishing Systems

C. Underwriters Laboratories, Inc. (UL):

..... Fire Protection Equipment Directory

D. Factory Mutual Engineering Corporation (FM):

..... Approval Guide

1.7 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the COR.

PART 2 - PRODUCTS

2.1 GENERAL

All equipment and components shall be new and the manufacturer's current model. All equipment and components shall be UL listed or FM approved for its intended use. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved.

2.2 CLEAN AGENT FIRE EXTINGUISHING SYSTEM

A. General:

1. The clean agent fire extinguishing system shall be UL listed and shall be in accordance with NFPA 2001.

B. Piping and fittings:

1. All piping and fittings shall be in compliance with NFPA 2001.
2. Multi-outlet fittings, other than tees, shall not be permitted.
3. All piping shall be reamed, blown clear, and swabbed with appropriate solvent to remove mill varnish and cutting oils before assembly.
4. Ordinary cast iron steel and non-metallic piping and fittings and flexible hoses shall not be used unless specifically required by the manufacturer.

C. Piping Support:

1. All piping shall be supported in accordance with the manufacturer's written instructions.
2. Piping shall be supported within 12 inches (304 mm) of discharge nozzles. The supports shall prevent the upward movement of the nozzle.

D. Storage Cylinders:

1. Provide storage cylinders as required by the manufacturer's written instructions and in accordance with NFPA 2001.
2. Cylinder assemblies shall be of steel construction designed to meet the requirements of the U.S. Department of Transportation.
3. Filling of the storage cylinders shall be by an authorized systems distributor in conjunction with a factory authorized agent filling station. Initial filling and recharge shall be performed in accordance with manufacturer's written instructions and shall not require replacement components for normal service.
4. Cylinders shall be securely attached to the wall. Provide factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
5. For halocarbon clean agents, storage cylinders shall be provided with a low agent pressure switch.

E. Valve Actuators:

1. Electric valve actuators shall be of brass construction and stackable design with swivel connections to allow removal of actuators for maintenance or testing.
2. Operation of actuators shall not require replacement of components. No electro-explosive devices may be used to actuate the valve assembly. Actuators shall include an indication if they are set or actuated.
3. Electric valve actuators shall be magnetic latch, continuous duty type for 24 VDC operation.
4. Actuation devices shall be UL listed or FM approved for use with the system.
5. Removal of the electric valve actuator shall cause a trouble on the clean agent control panel.

F. Discharge Nozzles:

1. Nozzles shall be permanently marked with the manufacturer's part number. The nozzles shall be threaded directly to the discharge piping without the use of special adaptors.

2.3 RELEASING SYSTEM

A. General

1. The releasing system shall be an analog addressable intelligent reporting, microprocessor controlled system, capable of remote sensitivity testing of the smoke detectors, and be installed in accordance with NFPA 70, NFPA 72, and NFPA 2001.

B. Clean Agent Control Panel:

1. General:
   a. The clean agent control panel shall be UL listed or FM approved and include a UL listed or FM approved releasing module.
   b. Each protected space shall be provided with its own clean agent control unit.
   c. All circuits shall be monitored for integrity.
   d. Visually and audibly annunciate all alarm, supervisory, and trouble signals including, but not limited to main power failure, open circuit, short circuit, ground faults, and system bypass activation.
   e. The panel or releasing module shall include a 0-60 second programmable timer.
   f. The clean agent control panel shall be provided with separate contacts to provide common supervisory, alarm, and trouble signals to the main building fire alarm system.
2. Enclosure:
   a. The clean agent control unit shall be housed in a cabinet suitable for both recessed and surface mounting. The cabinet and front panel shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
   b. The cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.
3. Power Supply:
   a. The clean agent control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
   b. The power supply for smoke detection systems shall be taken from the clean agent control unit.
4. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of an open, short circuit, or

ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

a. Initiating device circuits (IDC) shall be wired Class B in accordance with NFPA 72.
b. Signaling line circuits (SLC) shall be wired Class B in accordance with NFPA 72.
c. Notification appliance circuits (NAC) shall be wired Class B in accordance with NFPA 72.

5. Supervisory Alarm Devices: The low agent pressure switch and maintenance lock-out switch shall initiate a supervisory signal.
6. Trouble signals:
   a. Arrange the trouble signals for automatic reset (non-latching).
   b. System trouble switch off and on lamps shall be visible through the control unit door.
7. Function Switches: Provide the following switches in addition to any other switches required for the system:
   a. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the building fire alarm control unit when in the "off" position. A clean agent control unit system trouble signal shall be energized when switch is in the off position.
   b. Alarm Off Switch: Shall disconnect power to notification appliance circuits on the clean agent control panel. A system trouble signal shall be activated when the switch is in the off position.
   c. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
   d. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
   e. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
   f. AHU By-Pass: Provide a means to disable air handling units shutdown and dampers from closing upon operation of an initiating device designed to interconnect with these devices. A system trouble signal shall be activated when switch is in the off position.
8. Reset2 Capability: Each clean agent control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset.

C. Conduit, Boxes, and Wire

1. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:
    a. All new conduits shall be installed in accordance with NFPA 70.
    b. Conduit fill shall not exceed 40 percent of interior cross sectional area.
    c. All new conduits shall be 3/4 inch (19 mm) minimum.
2. Wire:
    a. Wiring shall be installed in conduit.
    b. Wiring shall be in accordance with NEC article 760, Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification appliance circuits.
    c. Signaling line circuits shall be twisted and shielded unless other wiring methods are specifically required by the fire alarm equipment manufacturer in writing.
3. Terminal Boxes, Junction Boxes, and Cabinets:
    a. These shall be galvanized steel in accordance with UL requirements.
    b. All boxes shall be sized and installed in accordance with NFPA 70.
    c. Covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "CA FA" or as directed by the COR for junction boxes and as "CLEAN AGENT FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
    d. Terminal boxes and cabinets shall have a volume 50 percent greater than required by NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
    e. Terminal boxes and cabinets shall have identified screw type terminal strips and shall be located in an accessible location. Terminal strips shall be labeled as to what circuit it is or as approved by the COR.

D. Standby Power Supply
1. Batteries:
    a. The batteries shall be of the sealed, maintenance free type, 24-volt nominal.

b. The batteries shall have sufficient capacity to power the clean agent control panel and its peripherals for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.

c. Battery racks shall be steel with an alkali-resistant finish.

2. Battery Charger:

a. The battery charger shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.

b. The battery charger shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

c. The battery charger shall have protection to prevent discharge through the charger.

d. The battery charger shall have protection for overloads and short circuits on both AC and DC sides.

e. A trouble condition shall actuate the fire alarm trouble signal.

f. The battery charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

E. Spot-type Smoke Detectors

1. Smoke detectors shall be photoelectric plug-in type and UL listed for use with the clean agent control panel being furnished. Each detector shall be monitored individually, via an integral, analog addressable element.

2. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.

3. Smoke detectors of the protected spaces shall be spaced in accordance with NFPA 72 for high air movement areas. Air velocities within the protected spaces shall be suitable for the listed detection air velocity range of the smoke detector.

4. Each protected space shall have at least 2 detectors.

5. Provide red stickers with an “A” on the ceiling below the location of the above ceiling smoke detectors when above ceiling detectors are provided. Provide red stickers with a “U” on the ceiling above the location of the under floor smoke detectors. Each sticker shall also include the address of the detector. The address shall be the same as that address that shows on the fire alarm control unit when the detector is activated.

6. For smoke detectors located under the floor, the smoke detectors shall be mounted with a steel angle or channel support independent of the raised floor structure. The smoke detectors shall be mounted in a vertical orientation.

F. Manual Activation Stations:

1. Shall be non-break glass, address reporting type.
2. Station front shall be constructed of durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Shall be of dual action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled “AGENT RELEASE.”
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until physically reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Shall be located at least 3.28 ft (1m) from any fire alarm manual pull station.

G. Notification Appliances:

1. Pre-discharge Bells:
   a. Shall be 24 VDC and be capable of producing an alarm signal of not less than 85 dBa at 10 feet.
   b. Shall be at least 6 inches (150 mm) in diameter.
2. Pre-discharge Strobes:
   a. Be listed in accordance with UL 1971.
   b. Shall be a minimum of 75 candela.
   c. Shall be provided with an amber lens.
   d. Shall be synchronized with other pre-discharge strobes in the protected space.
3. Discharge Strobes:
   a. Be listed in accordance with UL 1971.
   b. Shall be a minimum of 75 candela.
   c. Shall be provided with a red lens.
   d. Shall be synchronized with other discharge strobes outside the protected space.

H. Addressable Interface Module

1. Addressable interface modules shall be installed in individual boxes in accordance with the manufacturer’s product listing. The addressable interface module shall be provided with a protective cover provided by the device manufacturer. The protective cover shall have the

provision for viewing the operational LED of the addressable interface module. Addressable interface modules shall not be installed in a back-box with other devices or relays.

2. The installer shall provide, install, and test addressable interface modules as necessary to comply with the sequence of operations, whether shown on the drawings or not.

I. Graphic Floor Plans:

1. Provide readable scaled graphics of the protected area. The graphics shall show the location and address of each the ceiling smoke detectors, above ceiling smoke detectors, and under floor smoke detectors, on separate plans.
2. The graphic shall be framed and shall be located in an area approved by the COR.
3. Where approved by the COR a single graphic floor plan shall be permitted.

J. Abort Switches:

1. The abort switch front shall be constructed of durable material such as cast or extruded metal or high impact plastic. The abort switch shall be semi-flush type.
2. The abort switch shall not be a locking or keyed type.
3. The abort switch shall be of single action dead-man spring loaded type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "ABORT."

2.4 SWITCHES

A. Maintenance Lock-out Switch

1. Shall be key-operated only allowing the removal of the key in the "Normal" position. A red indicator lamp shall be included on the switch assembly to be illuminated when in the "Lock-out" position. The clean agent control panel shall indicate a supervisory alarm condition when in the "Lock-out" position.
2. The terminals shall be of the screw type.
3. Shall be provided adjacent to the clean agent control panel.

2.5 SIGNAGE

A. Signage shall have white lettering on a red plastic background.

B. The letters shall be 1 inch (25 mm) high with a stroke width of 3/8 inches (9.5 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a factory trained qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Install clean agent fire extinguishing system piping and fittings level and plumb, according to manufacturer's written instructions.

C. Where installing piping adjacent to equipment, allow space for service and maintenance.

D. Identity piping, agent storage cylinders, and control panels with signage in accordance with NFPA 2001.

E. Provide signage for the pre-discharge bells and strobes. The sign shall say "FIRE. [Agent Surname] RELEASE IMMINENT". The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the pre-discharge strobe.

F. Provide signage for the discharge strobes. The sign shall say "[Agent Surname] DISCHARGE". The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the discharge strobe.

G. Provide signage on the exterior of the protected space at each entrance. The sign shall say "THIS SPACE IS PROTECTED BY A CLEAN AGENT FIRE EXTINGUISHING SYSTEM. DO NOT ENTER WITHOUT AUTHORIZATION DURING OR AFTER DISCHARGE. THE RED STROBE INDICATES SYSTEM DISCHARGE." The sign shall be permanently affixed to the wall adjacent to the door.

H. Provide signage adjacent to each manual activation station. The sign shall say "ACTUATION OF THIS DEVICE WILL CAUSE FIRE SUPPRESSION GAS TO DISCHARGE. BEFORE ACTUATING, ENSURE THAT PERSONNEL ARE CLEAR OF THE AREA." The sign shall be permanently affixed to the wall within 12 inches (304 mm) of the station.

I. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.

J. Repairs: Repair damage to the building or equipment resulting from the installation of the clean agent fire extinguishing system by the installer at no additional expense to the Government.

K. Supervise clean agent control panel for alarm, supervisory, and trouble signals by the building fire alarm system in accordance with Section 28 31 00, FIRE DETECTION AND ALARM.

L. Where duct detectors are provided within computer room air conditioning units, addressable interface modules shall be used to monitor the activation of the duct detector as a supervisory signal on the clean agent control unit.

M. Control emergency power off with addressable interface modules.

3.2 SEQUENCE OF OPERATIONS

A. The clean agent extinguishing fire extinguishing system shall operate as follows:

1. Activation of any single smoke detector shall:
   a. Energize an alarm LED lamp on the activated detector and clean agent control panel.
   b. Transmit an alarm signal to the building's fire alarm system.
2. Activation of a second smoke detector shall:
   a. Energize an alarm LED lamp on the activator detector.
   b. Activate pre-discharge bell notification appliance and pre-discharge strobe notification appliance.
   c. Shut down power to electronic equipment within the protected space, close dampers, release door hold open devices, and shut down air handling units serving the protected space.
   d. Initiate a programmable 30-second time delay (agent release) sequence.
3. Activation of a manual activation station shall:
   a. Energize an alarm LED lamp on the clean agent control panel.
   b. Activate pre-discharge bell notification appliance and pre-discharge strobe notification appliance.
   c. Shut down power to electronic equipment within the protected space, close dampers, release door hold open devices, and shut down air handling units serving the protected space.
   d. Transmit an alarm signal to the building's fire alarm system.
   e. Initiate a programmable 20-second time delay (agent release) sequence.
4. Activation of the abort switch shall:
   a. Cease the time delay. Once the abort switch is released, the time delay countdown shall resume from where it ceased. The time delay shall not reset.
   b. Transmit a trouble signal to the building's fire alarm system.
5. Upon completion of the time delay, the system shall:
   a. De-energize the pre-discharge bell and pre-discharge strobe notification appliance.

b. Activate a discharge strobe notification appliance inside and outside of the protected area.

c. Energize valve actuator for agent cylinders releasing gaseous agent into the protected area.

6. Activation of the low agent tank pressure switch and maintenance lock-out switch shall:
   a. Energize a supervisory LED lamp on the clean agent control panel.
   b. Transmit a supervisory alarm signal to the building's fire alarm system.
7. Presence of any fault, bypass function, or removal of the electric valve actuator shall:
   a. Energize a trouble LED lamp on the clean agent control panel.
   b. Transmit a trouble signal to the building's fire alarm system.
8. Activation of duct detector within a computer room air condition unit shall energize a supervisory signal LED lamp on the clean agent control panel.

3.3 INSPECTION AND TEST

A. Room Enclosure Test: A room pressurization test shall be conducted for the protected space. The testing shall be done in accordance with NFPA 2001 Annex C. The contractor shall be responsible for sealing the enclosure to ensure the success of the room pressurization test. The test shall be deemed successful if the tested leakage rate is less than or equal to the leakage rate assumed in the calculations.

B. Pressure Test: Pneumatically pressure test piping in a closed circuit in accordance with NFPA 2001.

C. Flow Test: Subject system to a flow test utilizing nitrogen to verify that flow is continuous and that the piping and nozzles are unobstructed.

D. Preliminary Testing: System function operation test system as specified in NFPA 2001 and NFPA 72, in the presence of the COR or his designated representative.

E. Final Inspection and Testing: Subject system to tests in accordance with NFPA 2001 and NFPA 72, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.4 TRAINING

A. The manufacturer's authorized representative shall provide instruction and training to the VA on the dates requested by the COR as follows:

1. Six 1-hour sessions to employees working in protected area, engineering staff, security police and VA Fire Department personnel where there is a VA Fire Department present on site for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.

B. Each initial training session shall be videotaped.

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SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section will apply to all sections of Division 22.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Exterior: Piping and equipment exposed to weather be it temperature, humidity, precipitation, wind or solar radiation.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. A/E: Architect/Engineer
3. AISI: American Iron and Steel Institute
4. ASHRAE: American Society of Heating Refrigeration, Air Conditioning Engineers
5. ASJ: All Service Jacket
6. ASME: American Society of Mechanical Engineers
7. ASPE: American Society of Plumbing Engineers
8. AWG: American Wire Gauge
9. BACnet: Building Automation and Control Network
10. CD: Compact Disk
11. CDA: Copper Development Association
12. CGA: Compressed Gas Association
13. CFM: Cubic Feet per Minute
14. CI: Cast Iron
15. CLR: Color
16. CO: Contracting Officer
17. COR: Contracting Officer’s Representative
18. CPVC: Chlorinated Polyvinyl Chloride
19. DCW: Domestic Cold Water
20. DDC: Direct Digital Control
21. DFU: Drainage Fixture Units

22. DHW: Domestic Hot Water
23. DHWR: Domestic Hot Water Return
24. DHWS: Domestic How Water Supply
25. DN: Diameter Nominal
26. DO: Digital Output
27. DOE: Department of Energy
28. DVD: Digital Video Disc
29. DWG: Drawing
30. DWS: Domestic Water Supply
31. DWV: Drainage, Waste and Vent
32. EL: Elevation
33. EPA: Environmental Protection Agency
34. EPACT: Energy Policy Act
35. EPDM: Ethylene Propylene Diene Monomer
36. EPT: Ethylene Propylene Terpolymer
37. ETO: Ethylene Oxide
38. F: Fahrenheit
39. FAR: Federal Acquisition Regulations
40. FD: Floor Drain
41. FED: Federal
42. FG: Fiberglass
43. FNPT: Female National Pipe Thread
44. FOR: Fuel Oil Return
45. FOS: Fuel Oil Supply
46. FPM: Fluoroelastomer Polymer
47. FSK: Foil-Scrim-Kraft Facing
48. FSS: VA Construction & Facilities Management, Facility Standards Service
49. FU: Fixture Units
50. GAL: Gallon
51. GCO: Grade Cleanouts
52. GPD: Gallons per Day
53. GPH: Gallons per Hour

54. GPM: Gallons per Minute
55. HEX: Heat Exchanger
56. ID: Inside Diameter
57. IPC: International Plumbing Code
58. IPS: Iron Pipe Size
59. IW: Indirect Waste
60. lb: Pound
61. MAX: Maximum
62. MBH: 1000 Btu per Hour
63. MFG: Manufacturer
64. MIN: Minimum
65. NPTF: National Pipe Thread Female
66. NPS: Nominal Pipe Size
67. NPT: Nominal Pipe Thread
68. NTS: Not to Scale
69. PP: Polypropylene
70. ppb: Parts per Billion
71. ppm: Parts per Million
72. PSI: Pounds per Square Inch
73. PSIA: Pounds per Square Inch Atmosphere
74. PSIG: Pounds per Square Inch Gauge
75. PTFE: Polytetrafluoroethylene
76. PVC: Polyvinyl Chloride
77. PVDF: Polyvinylidene Fluoride
78. SAN: Sanitary Sewer
79. SPEC: Specification
80. SQFT/SF: Square Feet
81. SS: Stainless Steel
82. STD: Standard
83. TIL: Technical Information Library http//www.cfm.va.gov/til/indes.asp
84. T/P: Temperature and Pressure
85. TYP: Typical

86. USDA: U.S. Department of Agriculture
87. V: Vent
88. V: Volt
89. VA: Veterans Administration
90. VA CFM: VA Construction & Facilities Management
91. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
92. VAMC: Veterans Administration Medical Center
93. VHA OCAMES: This has been replaced by HEFP.
94. VSD: Variable Speed Drive
95. VTR: Vent through Roof
96. W: Waste

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
E. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
F. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
G. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
H. Section 07 84 00, FIRESTOPPING.
I. Section 07 92 00, JOINT SEALANTS.
J. Section 09 91 00, PAINTING.
K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
L. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
M. Section 22 07 11, PLUMBING INSULATION.
N. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
O. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

*Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below will form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society for Testing and Materials (ASTM):

A36/A36M.....Standard Specification for Carbon Structural Steel

A575-96.....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E84 .....Standard Test Method for Surface Burning Characteristics of Building Materials

E119 .....Standard Test Methods for Fire Tests of Building Construction and Materials

C. International Code Council, (ICC):

IBC .....International Building Code

IPC .....International Plumbing Code

D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

SP-58 .....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation

E. Military Specifications (MIL):

P-21035B.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

F. National Electrical Manufacturers Association (NEMA):

MG 1.....Motors and Generators

G. National Fire Protection Association (NFPA):

51B .....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

54 .....National Fuel Gas Code

70 .....National Electrical Code (NEC)

99 .....Healthcare Facilities Code

H. NSF International (NSF):

5 .....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment

14 .....Plastic Piping System Components and Related Materials

61 .....Drinking Water System Components – Health Effects

372 .....Drinking Water System Components – Lead Content

I. Department of Veterans Affairs (VA):

PG-18-102014(R18).....Plumbing Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, will be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section will be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

C. If the project is phased, contractors will submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan will be detailed enough to provide milestones in the process that can be verified.

D. Contractor will make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor will correct at no additional cost or time to the Government even if a submittal was approved.

E. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical will be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

F. Prior to submitting shop drawings for approval, Contractor will certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

G. Submittals and shop drawings for interdependent items, containing applicable descriptive information, will be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.

H. Manufacturer's Literature and Data including: Manufacturer's literature will be submitted under the pertinent section rather than under this section.

1. Equipment and materials identification.
2. Firestopping materials.
3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
4. Wall, floor, and ceiling plates.

I. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop drawings will include plan views, elevations and sections of all systems and will be on a scale of not less than 1:32 (3/8-inch equal to 1 foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings will clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
4. In addition, for plumbing systems, provide details of the following:
   a. Mechanical equipment rooms.
   b. Interstitial space.
   c. Hangers, inserts, supports, and bracing.
   d. Pipe sleeves.
   e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

J. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan will include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.

K. Plumbing Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   a. Include complete list indicating all components of the systems.
   b. Include complete diagrams of the internal wiring for each item of equipment.
   c. Diagrams will have their terminals identified to facilitate installation, operation and maintenance.
3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

L. Provide copies of approved plumbing equipment submittals to the TAB Subcontractor.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical, and associated systems will be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems will be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel will be experienced and qualified specialists in industrial and institutional plumbing.

B. Products Criteria:

1. Standard Products: Material and equipment will be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, will be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. Equipment Service: There will be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the

project. These organizations will come to the site and provide acceptable service to restore operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming will be submitted for project record and inserted into the operations and maintenance manual.

3. All items furnished will be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 will conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official will be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code will apply. Any conflicts will be brought to the attention of the Contracting Officers Representative (COR).
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units will be of the same manufacturer and model number, or if different models are required they will be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit will be the responsibility of the manufacturer of the completed assembly.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark will be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos is prohibited.
9. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

C. Welding: Before any welding is performed, Contractor will submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME BPVC, Section IX, "Welding and Brazing Qualifications". Provide proof of current certification to CO.
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds will be stamped according to the provisions of the AWS or ASME as required herein and by the association code.

D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations will be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

E. Execution (Installation, Construction) Quality:

1. All items will be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents will be referred to the COR for resolution. Printed copies or electronic files of manufacturer’s installation instructions will be provided to the COR at least 10 working days prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, will be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution. Failure of the Contractor to resolve or call attention to any discrepancies or deficiencies to the COR will result in the Contractor correcting at no additional cost or time to the Government.
3. Complete layout drawings will be required by Paragraph, SUBMITTALS. Construction work will not start on any system until the layout drawings have been approved by VA.
4. Installer Qualifications: Installer will be licensed and will provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.

5. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work will be removed and done again at no additional cost or time to the Government.

F. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

G. Guaranty: Warranty of Construction, FAR clause 52.246-21.

H. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions will be considered mandatory, the word “should” will be interpreted as “will”. Reference to the “code official” or “owner” will be interpreted to mean the COR.

I. Cleanliness of Piping and Equipment Systems:

1. Care will be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping will be removed.
2. Piping systems will be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks will be cleaned prior to delivery and beneficial use by the Government. All piping will be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets will be flushed of debris prior to final acceptance.
4. Contractor will be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site will remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
2. Damaged equipment will be replaced with an identical unit as determined and directed by the COR. Such replacement will be at no additional cost or additional time to the Government.

3. Interiors of new equipment and piping systems will be protected against entry of foreign matter. Both inside and outside will be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor will be under the custody and responsibility of the Contractor and will be protected as required for new work.
5. Protect plastic piping and tanks from ultraviolet light (sunlight) while in pre-construction. Plastic piping and tanks will not be installed exposed to sunlight without metal jacketing to block ultraviolet rays.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be submitted via approved electronic file transfer. One copy of operation and maintenance manuals shall be inserted into a three–ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation will be included in the operation and maintenance manual. The operations and maintenance manual will include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices will be included. A List of recommended spare parts (manufacturer, model number, and quantity) will be furnished. Information explaining any special knowledge or tools the owner will be required to employ will be inserted into the As-Built documentation.

C. The installing Contractor will maintain as-built drawings of each completed phase for verification; and, will provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it will not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version 2023 provided on CD or DVD. The CAD drawings will use multiple line layers with a separate individual layer for each system.

D. The as-built drawings will indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation will be provided to COR 21 working days prior to submitting the request for final inspection. The documentation will include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results will contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results will include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least 10 working days advance notice to the COR. The request will include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan 5 work days prior to the shutdown or it will need to be rescheduled.

D. Phasing of Work: Comply with all requirements shown on contract documents. Contractor will submit a complete detailed phasing plan/schedule with manpower levels prior to commencing work. The phasing plan will be detailed enough to provide milestones in the process that can be verified.

E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief

periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

F. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

A. Solder or flux containing lead will not be used with copper pipe.

B. Material or equipment containing a weighted average of greater than 0.25 percent lead will not be used in any potable water system intended for human consumption and will be certified in accordance with NSF 61 or NSF 372.

C. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers will comply with NSF 61 and NSF 372.

D. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components will be maximized to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others will assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike will be products of a single manufacturer.
3. Components will be compatible with each other and with the total assembly for intended service.
4. Contractor will guarantee performance of assemblies of components and will repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Government.

C. Components of equipment will bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, will be the same make and model.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed will be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4 SAFETY GUARDS

A. Pump shafts and couplings will be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material will be minimum 16-gauge sheet steel; ends will be braked and drilled and attached to pump base with minimum of four 8 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

B. B. All Equipment will have moving parts protected from personal injury.

2.5 LIFTING ATTACHMENTS

A. Equipment will be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments will withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods used will conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems will be provided. Premium efficient motors will be provided. Unless otherwise specified for a particular application, electric motors will have the following requirements.

B. Special Requirements:
   1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 at no additional cost or time to the Government.
   2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices will be in accordance with the requirements of this specification.
   3. Wire and cable materials specified in the electrical division of the specifications will be modified as follows:
      a. Wiring material located where temperatures can exceed 71° C (160° F) will be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.
      b. Other wiring at boilers and water heaters, and to control panels, will be NFPA 70 designation THWN.
      c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems will be provided where recommended by manufacturer of equipment.
   4. Motor sizes will be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps will be sized for non-overloading at all points on the pump performance curves.
   5. Motors utilized with variable frequency drives will be rated “inverter-ready” per NEMA Standard, MG1.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency or Premium Efficiency” by the project specifications on driven equipment, will conform to efficiency and power factor requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act (EPACT), revised 2005. Motors not specified as “high efficiency or premium efficient” will comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor will have two separate windings. A time delay (20 seconds minimum) relay will be provided for switching from high to low speed.

F. Rating: Rating will be continuous duty at 100 percent capacity in an ambient temperature of 40° C (104° F); minimum horsepower as shown on drawings; maximum horsepower in normal operation will not exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame will be measured at the time of final inspection.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, MOTOR CONTROLLERS for specifications.

B. The combination of controller and motor will be provided by the respective pump manufacturer and will be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, will be product of a single manufacturer.

C. Motors will be premium efficient type, “invertor duty”, and be approved by the motor controller manufacturer. The controller-motor combination will be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor sheaves will be fixed pitch.

D. Controller will not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor will be affected from other devices on the AC power system.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown in the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with local VAMC shops. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING will be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. will be identified.

C. Control Items: All temperature, pressure, and controllers will be labeled and the component’s function identified. Identify and label each item as they appear on the control diagrams.

D. Valve Tags and Lists:

1. Plumbing: All valves will be provided with valve tags and listed on a valve list (Fixture stops not included).
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gauge, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Valve lists will be created using a word processing program and printed on plastic coated cards. The plastic-coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) will show valve tag number, valve function and area of control for each service or system. The valve list will be in a punched 3-ring binder notebook. An additional copy of the valve list will be mounted in picture frames for mounting to a wall. COR will instruct Contractor where frames will be mounted.
4. A detailed plan for each floor of the building indicating the location and valve number for each valve will be provided in the 3-ring binder notebook. Each valve location will be identified with a color-coded sticker or thumb tack in ceiling or access door.

2.9 FIRESTOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

2.10 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC)and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.Submittals based on the International Building Code (IBC) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS requirements, or the following paragraphs of this Section will be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) will be submitted for approval of the COR in all cases. See the above specifications for lateral force design requirements.

B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58.

C. For Attachment to Concrete Construction:

1. Concrete insert: Type 18, MSS SP-58.
2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

D. For Attachment to Steel Construction: MSS SP-58.
1. Welded attachment: Type 22.
2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

E. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles will provide (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

F. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, 2.7 mm (No. 12 gauge), designed to accept special spring held, hardened steel nuts.
1. Allowable hanger load: Manufacturers rating less 200 pounds.
2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4 inchU-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two1/2 inch galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.

G. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
1. General Types (MSS SP-58):
   a. Standard clevis hanger: Type 1; provide locknut.
   b. Riser clamps: Type 8.
   c. Wall brackets: Types 31, 32 or 33.
   d. Roller supports: Type 41, 43, 44 and 46.
   e. Saddle support: Type 36, 37 or 38.

f. Turnbuckle: Types 13 or 15.

g. U-bolt clamp: Type 24.

h. Copper Tube:

1) Hangers, clamps and other support material in contact with tubing will be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.

2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.

3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.

4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending 1 inch beyond steel support or clamp. Spring Supports (Expansion and contraction of vertical piping):

1) Movement up to 3/4 inch: Type 51 or 52 variable spring unit with integral turn buckle and load indicator.

2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

j. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping (Other Than General Types):

a. Horizontal piping: Type 1, 5, 7, 9, and 10.

b. Chrome plated piping: Chrome plated supports.

c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.

d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gauge) minimum.

H. Pre-insulated Calcium Silicate Shields:

1. Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.

2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.

3. Shield thickness will match the pipe insulation.

4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
    a. Shields for supporting cold water will have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
    b. The insulated calcium silicate shield will support the maximum allowable water filled span as indicated in MSS SP-58. To support the load, the shields will have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

I. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.11 PIPE PENETRATIONS

A. Pipe penetration sleeves will be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.

B. Pipe penetration sleeve materials will comply with all firestopping requirements for each penetration.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:
    1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
    2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
    3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

D. Penetrations are prohibited through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.

E. Sheet metal, plastic, or moisture resistant fiber sleeves will be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

F. Cast iron or zinc coated pipe sleeves will be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe will be made watertight with a modular or link rubber seal. The link seal will be applied at both ends of the sleeve.

G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves will be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve will be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves will be connected with a floor plate.

H. Brass Pipe Sleeves will be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve will be connected with a floor plate.

I. Sleeve clearance through floors, walls, partitions, and beam flanges will be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation will be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings will be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

J. Sealant and Adhesives: Will be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials will be utilized when possible.

K. Pipe passing through roof will be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange will extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane will be provided with a clamping flange. The annular space between the sleeve and pipe will be sealed watertight.

2.12 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.

D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application. Bio-based materials will be utilized when possible.

2.13 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates will be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint will be provided in spaces where brass or steel pipe sleeves are specified.

2.14 ASBESTOS

Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions will be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment will be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings will be prepared to coordinate proper location and personnel access of all facilities. The drawings will be submitted for review.

B. Manufacturer's published recommendations will be followed for installation methods not otherwise specified.

C. Operating Personnel Access and Observation Provisions: All equipment and systems will be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gauges and indicators will be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown in the drawings will not be changed nor reduced.

D. Structural systems necessary for pipe and equipment support will be coordinated to permit proper installation.

E. Location of pipe sleeves, trenches and chases will be accurately coordinated with equipment and piping locations.

F. Cutting Holes:
   1. Holes will be located to avoid interference with structural members such as beams or grade beams. Holes will be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter will be referred to COR for approval.
   2. Waterproof membrane will not be penetrated. Pipe floor penetration block outs will be provided outside the extents of the waterproof membrane.
   3. Holes through concrete and masonry will be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.
H. Protection and Cleaning:
   1. Equipment and materials will be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, will be replaced at no additional cost or time to the Government.
   2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures will be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
I. Gauges, thermometers, valves and other devices will be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gauges will be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing will not require dismantling adjacent equipment or pipe work.
J. Domestic cold and hot water systems interface with the HVAC control system for the temperature, pressure and flow monitoring requirements to mitigate legionella. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.
K. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

L. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons will be sealed with plumbers' putty.

M. Switchgear Drip Protection: Every effort will be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve will be provided in low point of casement pipe.

N. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment will be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes will be drilled or burned in structural steel ONLY with the prior written approval of the COR.

B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above will not be permitted. Rusty products will be replaced.

C. Hanger rods will be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work will be provided.

D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.

E. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems will be supported in channel troughs.

F. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems will be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports will not be located and installed until equipment mounted thereon has been approved. Bases will be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings will be reviewed for additional requirements. Bases will be neatly finished and smoothed, will have chamfered edges at the top, and will be suitable for painting.
3. All equipment will be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts will be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.3 LUBRICATION

A. All equipment and devices requiring lubrication will be lubricated prior to initial operation. All devices and equipment will be field checked for proper lubrication.

B. All devices and equipment will be equipped with required lubrication fittings. A minimum of 1 liter (1 quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application will be provided. All materials will be delivered to COR in unopened containers that are properly identified as to application.

C. A separate grease gun with attachments for applicable fittings will be provided for each type of grease applied.

D. All lubrication points will be accessible without disassembling equipment, except to remove access plates.

E. All lubrication points will be extended to one side of the equipment.

3.4 PLUMBING SYSTEMS DEMOLITION

A. Rigging access, other than indicated in the drawings, will be provided after approval for structural integrity by the COR. Such access will be provided at no additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris will be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

B. In an operating plant, cleanliness and safety will be maintained. The plant will be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work will be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris will not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting will be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities will be available at all times. All work will be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VAMC, and the Contractor will follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work will be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings will be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system will be maintained. Reference will also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

D. All valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells will remain Government property and will be removed and delivered to COR and stored as directed. The Contractor will remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material will be removed from Government property expeditiously and will not be allowed to accumulate. Coordinate with the COR and Infection Control.

E. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

3.5 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems will be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning will be thorough. Solvents, cleaning materials and methods recommended by the manufacturers will be used for the specific tasks. All rust will be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions will be repaired prior to applying prime and finish coats.
2. The following Material and Equipment will NOT be painted:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Name plates.
3. The final result will be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment will be repainted, if necessary, to achieve this. Lead based paints will not be used.

3.6 IDENTIFICATION SIGNS

3.7 STARTUP AND TEMPORARY OPERATION

Startup of equipment will be performed as described in the equipment specifications. Vibration within specified tolerance will be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.8 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, all required tests will be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests will be requested in writing to COR for approval.

3.9 OPERATION AND MAINTENANCE MANUALS

A. All new and temporary equipment and all elements of each assembly will be included.
B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information will be included.
C. Manufacturer’s installation, maintenance, repair, and operation instructions for each device will be included. Assembly drawings and parts lists will also be included. A summary of operating precautions and reasons for precautions will be included in the Operations and Maintenance Manual.
D. Lubrication instructions, type and quantity of lubricant will be included.
E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications will be included.
F. Set points of all interlock devices will be listed.
G. Trouble-shooting guide for the control system troubleshooting will be inserted into the Operations and Maintenance Manual.

H. The control system sequence of operation corrected with submittal review comments will be inserted into the Operations and Maintenance Manual.

I. Emergency procedures for shutdown and startup of equipment and systems.

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SECTION 22 05 12
GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the general motor requirements for plumbing equipment and applies to all sections of Division 22.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

G. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

H. Section 26 24 19, MOTOR-CONTROL CENTERS: Motor Control Centers.

I. Section 26 29 11, MOTOR CONTROLLERS: Starters, control and protection of motors.

1.3 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and VHA standard will govern.

B. American Bearing Manufacturers Association (ABMA):

ABMA 9 ..... Load Ratings and Fatigue Life for Ball Bearings

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

112 ..... IEEE Standard Test Procedure for Polyphase Induction Motors and Generators

841 .....IEEE Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors--Up to and Including 370 kW (500 HP)

D. International Code Council (ICC):

IPC .....International Plumbing Code

E. National Electrical Manufacturers Association (NEMA):

MG 1.....Motors and Generators

MG 2.....Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

250 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA):

70 .....National Electrical Code (NEC)

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT”, with applicable paragraph identification.

C. Submit motor submittals with drive equipment.

D. Shop Drawings:

1. Provide documentation to demonstrate compliance with contract documents.
2. Motor nameplate information shall be submitted including electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
3. Motor parameters required for the determination of the Reed Critical Frequency of vertical hollow shaft motors shall be submitted.

E. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. iagrams shall have their terminals identified to facilitate installation, operation and maintenance.

G. Certification: Two weeks prior to final inspection, unless otherwise noted, the following certification shall be submitted to the Contracting Officer's Representative (COR).
   1. Certification shall be submitted stating that the motors have been properly applied, installed, adjusted, lubricated, and tested.

H. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 MOTORS

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, MOTOR CONTROLLERS; and Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors. Unless otherwise specified for a particular application, use electric motors with the following requirements.

B. For alternating current, fractional and integral horsepower motors, NEMA MG 1 and NEMA MG 2 shall apply.

C. For severe duty totally enclosed motors, IEEE 841 shall apply. For severe duty totally enclosed motors, IEEE 841 shall apply.

D. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.

1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Voltage ratings shall be as follows:

1. Single phase:

a. Motors connected to 120-volt systems: 115 volts.

b. Motors connected to 208-volt systems: 200 volts.

c. Motors connected to 240-volt or 480-volt systems: 230/460 volts, dual connection.

2. Three phase:

a. Motors connected to 208-volt systems: 200 volts.

b. Motors, less than 74.6 kW (100 HP), connected to 240-volt or 480-volt systems: 230/460 volts, dual connection.

G. Number of phases shall be as follows:

1. Motors, less than 373 W (1/2 HP): Single phase.

2. Motors, 373 W (1/2 HP) and greater: 3 phase.

3. Exceptions:

a. Hermetically sealed motors.

b. Motors for equipment assemblies, less than 746 W (1 HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

H. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

I. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting, acceleration and running torque without exceeding nameplate ratings or considering service factor.

J. Motor Enclosures:
   1. Shall be the NEMA types as specified and/or shown in the Contract Documents.
   2. Where the types of motor enclosures are not shown in the drawings, they shall be the NEMA types per NEMA 250, which are most suitable for the environmental conditions where the motors are being installed. Enclosure requirements for certain conditions are as follows:
      a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.
      b. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.
      c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.
   3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

K. Electrical Design Requirements:
   1. Motors shall be continuous duty.
   2. The insulation system shall be rated minimum of Class B, 130 degrees C (266 degrees F).
   3. The maximum temperature rise by resistance at rated power shall not exceed Class B limits, 80 degrees C (144 degrees F).
   4. The speed/torque and speed/current characteristics shall comply with NEMA Design A or B, as specified.
   5. Motors shall be suitable for full voltage starting, unless otherwise noted. Coordinate motor features with applicable motor controllers.
   6. Motors for variable frequency drive applications shall adhere to NEMA MG 1, Part 30, Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable Voltage or Adjustable Frequency Controls, or both, or NEMA MG 1, Part 31, Definite Purpose Inverter Fed Polyphase Motors.

L. Mechanical Design Requirements:
   1. Bearings shall be rated for a minimum fatigue life of 26,280 hours for belt-driven loads and 100,000 hours for direct-drive loads based on L10 (Basic Rating Life) at full load direct

coupled, except vertical high thrust motors which require a 40,000 hour rating. A minimum fatigue life of 40,000 hours is required for VFD drives.

2. Vertical motors shall be capable of withstanding a momentary up thrust of at least 30 percent of normal down thrust.
3. Grease lubricated bearings shall be designed for electric motor use. Grease shall be capable of the temperatures associated with electric motors and shall be compatible with Polyurea based greases.
4. Grease fittings, if provided, shall be Alemite type or equivalent.
5. Oil lubricated bearings, when specified, shall have an externally visible sight glass to view oil level.
6. Vibration shall not exceed 3.8 mm (0.15 inch) per second, unfiltered peak.
7. Noise level shall meet the requirements of the application.
8. Motors on 180 frames and larger shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
9. All external fasteners shall be corrosion resistant.
10. Condensation heaters, when specified, shall keep motor windings at least 5 degrees C (9 degrees F) above ambient temperature.
11. Winding thermostats, when specified shall be normally closed, connected in series.
12. Grounding provisions shall be in the main terminal box.

M. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional cost or time to the Government.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA MG 1, Part 31, Definite-Purpose Inverter-Fed Polyphase Motors. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

N. Additional requirements for specific motors, as indicated in other sections, shall also apply.

O. NEMA Premium Efficiency Electric Motors, Motor Efficiencies: All permanently wired polyphase motors of1 HP or greater shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of1 HP or greater with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Efficiencies Open Drip-Proof				Minimum Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

P. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM. Power factor correction capacitors shall be provided unless the motor meets the 0.9 requirement without it or if the motor is controlled by a variable frequency drive. The power factor correction capacitors shall be able to withstand high voltage transients and power line variations without breakdown.

Q. Energy Efficiency of Small Motors (Motor Efficiencies): All motors under 746 W (1 hp) shall meet the requirements of the DOE Small Motor Regulation.

Polyphase Open Motors Average full load efficiency				Capacitor-start capacitor-run and capacitor-start induction run open motors Average full load efficiency			
Rating kW (hp)	**6 poles**	**4 poles**	**2 poles**	**Rating kW (hp)**	**6 poles**	**4 poles**	**2 poles**
0.18 (0.25)	67.5	69.5	65.6	0.18 (0.25)	62.2	68.5	66.6
0.25 (0.33)	71.4	73.4	69.5	0.25 (0.33)	66.6	72.4	70.5
0.37 (0.5)	75.3	78.2	73.4	0.37 (0.5)	76.2	76.2	72.4
0.55 (0.75)	81.7	81.1	76.8	0.55 (0.75)	80.2	81.8	76.2

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown in the drawings and/or as required by other sections of these specifications.

B. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 FIELD TESTS

A. All tests shall be witnessed by the CxA or by the COR.

B. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before startup. All shall test free from grounds.

C. Perform Load test in accordance with IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

D. Insulation Resistance: Not less than 1/2 meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

E. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

- - - E N D - - -

SECTION 22 05 19
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for water meters and gauges primarily used for troubleshooting the system and to indicate system performance.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Components intended to be connected to BAS shall be furnished under Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC for installation under this section.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

G. Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEMS FOR HAVC.

1.3 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B40.100 ..... Pressure Gauges and Gauge Attachments

B40.200 ..... Thermometers, Direct Reading and Remote Reading

C. American Water Works Association (AWWA):

C700 ..... Cold Water Meters, Displacement Type, Bronze Main Case

C701 .....Cold Water Meters-Turbine Type, for Customer Service

C702 .....Cold Water Meters – Compound Type

C707-2010.....Encoder-Type Remote-Registration Systems for Cold-Water Meters

D. Institute of Electrical and Electronics Engineers (IEEE):

C2 .....National Electrical Safety Code (NESC)

E. International Code Council (ICC):

IPC .....International Plumbing Code

F. National Fire Protection Association (NFPA):

70 .....National Electrical Code (NEC)

G. NSF International (NSF):

61 .....Drinking Water System Components – Health Effects

372 .....Drinking Water System Components – Lead Content

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 19, METERS AND GAUGES FOR PLUMBING PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Water Meter.
2. Pressure Gauges.
3. Thermometers.
4. Product certificates for each type of meter and gauge.
5. BACnet communication protocol.

D. Complete operating and maintenance manual shall including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the system.
2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 DISPLACEMENT WATER METER

A. For pipe sizes 50 mm (2 inches) and smaller, the water meter shall be displacement type, full size nutating disc, magnetic drive, sealed register, and fully conform to AWWA C700. Peak domestic flow shall be 2.2 L/s (34 gpm). The meter register shall indicate flow in liters (U.S. gallons).

B. The water meter shall be rated for use at temperatures ranging from -40 degrees C (-40 degrees F) and 70 degrees C (158 degrees F) and operate at a working pressure of 1035 kPa (150 psig).

C. The meter case, bottom caps, and register box lids shall be constructed from cast bronze.

D. The meter shall register plus or minus 3 percent of the water actually passing through it at any rate of flow within the normal test flow limits specified in AWWA 700.

E. The water meter shall conform to NSF 61 and NSF 372.

2.2 PRESSURE GAUGES FOR WATER USAGE

A. ASME B40.100 all metal case 115 mm (4-1/2 inches) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1380 kPa (0 to 200 psig) gauge.

B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.

C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psig.

D. The pointer shall be dark colored metal.

E. The window shall be glass.

F. The ring shall be brass or stainless steel.

G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.

H. The pressure gauge for water domestic use shall conform to NSF 61 and NSF 372.

2.3 THERMOMETERS

Thermometers shall be straight stem, metal case, red liquid-filled thermometer, approximately 175 mm (7 inches) high, 4 degrees C to 100 degrees C (40 degrees F to 212 degrees F). Thermometers shall comply with ASME B40.200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Direct mounted pressure gauges shall be installed in piping tees with pressure gauge located on pipe at the most readable position.

B. Valves and snubbers shall be installed in piping for each pressure gauge.

C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.

D. Pressure gauges shall be installed where indicated in the drawings and at the following locations:

1. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

E. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 FIELD QUALITY CONTROL

The meter assembly shall be visually inspected and operationally tested. The correct multiplier placement on the face of the meter shall be verified.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

- - - E N D - - -

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

A112.14.1 ..... Backwater Valves

C. American Society of Sanitary Engineering (ASSE):

1001 ..... Performance Requirements for Atmospheric Type Vacuum Breakers

1003 ..... Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems

1011 ..... Performance Requirements for Hose Connection Vacuum Breakers

1013 ..... Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers

1015 ..... Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

1017 ..... Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

1020 ..... Performance Requirements for Pressure Vacuum Breaker Assembly

1035 ..... Performance Requirements for Laboratory Faucet Backflow Preventers

1069 ..... Performance Requirements for Automatic Temperature Control Mixing Valves

1070 ..... Performance Requirements for Water Temperature Limiting Devices

1071 ..... Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

D. American Society for Testing and Materials (ASTM):

A126-2004..... Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A276/A276M..... Standard Specification for Stainless Steel Bars and Shapes

A536-1984..... Standard Specification for Ductile Iron Castings

B62 ..... Standard Specification for Composition Bronze or Ounce Metal Castings

B584 ..... Standard Specification for Copper Alloy Sand Castings for General Applications

E. International Code Council (ICC):

IPC ..... International Plumbing Code

F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-25 ..... Standard Marking Systems for Valves, Fittings, Flanges and Unions

SP-67 .....Butterfly Valves

SP-70 .....Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80 .....Bronze Gate, Globe, Angle, and Check Valves

SP-85 .....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends

SP-110 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

G. National Environmental Balancing Bureau (NEBB):

8th Edition.....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

H. NSF International (NSF):

61 .....Drinking Water System Components – Health Effects

372 .....Drinking Water System Components – Lead Content

I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):

10th Edition.....Manual of Cross-Connection Control

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Ball Valves.
2. Gate Valves.
3. Butterfly Valves.
4. Balancing Valves.
5. Check Valves.
6. Globe Valves.
7. Water Pressure Reducing Valves and Connections.

8. Backwater Valves.
9. Backflow Preventers.
10. Chainwheels.
11. Thermostatic Mixing Valves.

D. Test and Balance reports for balancing valves.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
4. Piping diagrams of thermostatic mixing valves to be installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Valves shall be prepared for storage as follows:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature.

C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

1.6 AS BUILT DOCUMENTATION

Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.

B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing greater than 15 percent zinc shall not be permitted.

C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

F. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

G. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:

1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584. The ends shall be non-lead solder.

2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.

3. 100 mm DN100 (4 inches) and greater:

   a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze

trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and greater.

b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.

c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two-piece stainless-steel stem, Buna-N EPDM encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.

B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

2.3 MANUAL BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitted with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

B. Greater than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 CHECK VALVES

A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard.

The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

B. 100 mm or DN100 (4 inches) and greater:
   1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
   2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5 GLOBE VALVES

A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.

B. Greater than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.

B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.

C. Threads on valve and mating pipe shall be examined for form and cleanliness.

D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

C. Valves shall be installed in horizontal piping with stem at or above center of pipe.

D. Valves shall be installed in a position to allow full stem movement.
Chains shall be extended to 1524 mm (60 inches) above finished floor.

E. Check valves shall be installed for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

F. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that shall be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.

1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are prohibited for this application.

G. Install pressure gauges on outlet of backflow preventers.

H. Do not install bypass piping around backflow preventers.

I. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.

1. Install thermometers if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

J. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

K. Install thermostatic balancing valves with inlet strainer and inlet and outlet isolation valves.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.
   2. Master, thermostatic, water mixing valves.
   3. Manifold, thermostatic, water-mixing-valve assemblies.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the VA Contracting Officer's Representative (COR).

3.5 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.6 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for the following:

1. Plumbing piping and equipment.

PART 2 - 2. Re-insulation of plumbing piping and equipment after asbestos abatement and or replacement of any part of existing insulation system (insulation, vapor retarder jacket, protective coverings/jacket) damaged during construction.

A. Definitions:

1. ASJ: All Service Jacket, Kraft paper, white finish facing or jacket.
2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
3. All insulation systems installed within supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, interiors of air conditioned or heating ducts, and mechanical equipment rooms shall be noncombustible or shall be listed and labeled as having a flame spread indexes of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Note: ICC IMC, Section 602.2.1.
4. Cold: Equipment or piping handling media at design temperature of 15 degrees C (60 degrees F) or below.
5. Concealed: Piping above ceilings and in chases, and pipe spaces.
6. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
7. FSK: Foil-scrim-Kraft facing.
8. Hot: Plumbing equipment or piping handling media above 40 degrees C (104 degrees F).
9. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
10. Thermal conductance: Heat flow rate through materials.
    a. Flat surface: Watts per square meter (BTU per hour per square foot).
    b. Pipe or Cylinder: Watts per linear meter (BTU per hour per linear foot) for a given outside diameter.

11. Thermal Conductivity (k): Watts per meter, per degree K (BTU - inch thickness, per hour, per square foot, per degree F temperature difference).
12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
13. HWR: Hot water recirculating.
14. CW: Cold water.
15. HW: Hot water.
16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

2.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Insulation material and insulation production method.
D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
E. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Insulation containing asbestos material.
F. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
G. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
H. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING: Hot and cold water piping.
I. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
K. Section 23 21 13, HYDRONIC PIPING: electrical heat tracing systems.

2.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
B. American Society for Testing and Materials (ASTM):

B209 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411 .....Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449-2007 .....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C450-2008 .....Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

Adjunct to C450 .....Compilation of Tables that Provide Recommended Dimensions for Prefab and Field Thermal Insulating Covers, etc.

C533 .....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C534/C534M .....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C547 .....Standard Specification for Mineral Fiber Pipe Insulation

C552 .....Standard Specification for Cellular Glass Thermal Insulation

C553 .....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C591 .....Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

C680 .....Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs

C612-2014 .....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126 .....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136 .....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

C1710 .....Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form

D1668/D1668M .....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

E84 .....Standard Test Method for Surface Burning Characteristics of Building Materials

E2231 .....Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics

C. Federal Specifications (Fed. Spec.):

L-P-535E .....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

D. International Code Council, (ICC):

IMC.....International Mechanical Code

E. Military Specifications (Mil. Spec.):

MIL-A-3316C (2) .....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (2).....Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-PRF-19565C (1) .....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H .....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

F. National Fire Protection Association (NFPA):

90A.....Standard for the Installation of Air-Conditioning and Ventilating Systems

G. Underwriters Laboratories, Inc (UL):

723 .....Standard for Test for Surface Burning Characteristics of Building Materials

1887 .....Standard for Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics

H. 3E Plus® version 4.1 Insulation Thickness Computer Program: Available from NAIMA with free download; https://insulationinstitute.org/tools-resources/

2.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM Designation, Federal and Military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used and state surface burning characteristics.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation shall follow the guidelines in accordance with ASTM C1710.
   e. Make reference to applicable specification paragraph numbers for coordination.
   f. All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.

E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

2.5 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.11.2.6, parts of which are quoted as follows:

   4.3.3.1 Pipe and duct insulation and coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels and duct silencers used in duct systems shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with ASTM E84 and appropriate mounting practice, e.g. ASTM E2231.

   4.3.3.3 Coverings and linings for air ducts, pipes, plenums and panels including all pipe and duct insulation materials shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service. In no case shall the test temperature be below 121 degrees C (250 degrees F).

4.3.11.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.11.2.6.8 Smoke detectors shall not be required to meet the provisions of Section 4.3.

2. Test methods: ASTM E84, UL 723, and ASTM E2231.
3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

2.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions via electronic file transfer. One copy of operation and maintenance manuals shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished.

Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2023 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

2.7 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe insulation jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 3 - PRODUCTS

3.1 MINERAL FIBER OR FIBER GLASS

A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m^3 (nominal 3 pcf), k = 0.037 (.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F).

B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m^3 (nominal 1 pcf), k = 0.045 (0.31) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F).

C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (446 degrees F) with an all service vapor retarder jacket (ASJ) and with polyvinyl chloride (PVC) premolded fitting covering.

3.2 CELLULAR GLASS CLOSED-CELL

A. Comply with Standard ASTM C552, density 120 kg/m^3 (7.5 pcf) nominal, k = 0.033 (0.29) at 24 degrees C (75 degrees F).

B. Pipe insulation for use at process temperatures below ambient air to 482 degrees C (900 degrees F) with or without all service vapor retarder jacket (ASJ).

C. Pipe insulation for use at process temperatures for pipe and tube below ambient air temperatures or where condensation control is necessary are to be installed with a vapor retarder/barrier system of with or without all service vapor retarder sealed jacket (ASJ) system. Without ASJ shall require all longitudinal and circumferential joints to be vapor sealed with vapor barrier mastic.

D. Cellular glass thermal insulation intended for use on surfaces operating at temperatures between −268 and 482 degrees C (−450 and 900 degrees F). It is possible that special fabrication or techniques for pipe insulation, or both, shall be required for application in the temperature range from 121 to 427 degrees C (250 to 800 degrees F).

3.3 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be ASJ or PVDC Vapor Retarder jacketing.

B. ASJ shall be white finish (kraft paper) bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture is 50 units, suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: FSK or PVDC type for concealed ductwork and equipment.

D. Except for flexible elastomeric cellular thermal insulation (not for high humidity exposures), field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping in high humidity locations or conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

E. Except for cellular glass thermal insulation, when all longitudinal and circumferential joints are vapor sealed with a vapor barrier mastic or caulking, vapor barrier jackets may not be provided.

For aesthetic and physical abuse applications, exterior jacketing is recommended. Otherwise field applied vapor barrier jackets shall be provided, in addition to the applicable specified facings and jackets, on all exterior piping as well as on interior piping in high humidity locations or conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

F. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2070 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be PVC conforming to Fed Spec L-P-535E, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape. Staples, tacks, or any other attachment that penetrates the PVC covering is not allowed on any form of a vapor barrier system in below ambient process temperature applications.

H. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated or with cut aluminum gores to match shape of fitting and of 0.6 mm (0.024 inch) minimum thickness aluminum. Aluminum fittings shall be of same construction with an internal moisture barrier as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands with wing seals shall be installed on all circumferential joints. Bands shall be 15 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

I. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

3.4 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	**Insert Blocks mm (inches)**
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be cellular glass. . Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m^3 (3.0 pcf).

3.5 ADHESIVE, MASTIC, CEMENT

A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.

B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.

C. Mil. Spec. MIL-A-24179A, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.

D. Mil. Spec. MIL-PRF-19565C, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-PRFC-19565C, Type I or Type II: Vapor barrier compound for indoor use.

F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

3.6 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching galvanized steel. Staples are not allowed for below ambient vapor barrier applications.

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy or stainless steel.

D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

E. Tacks, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall NOT be used to attach/close the any type of vapor retarder jacketing. Thumb tacks

sometimes used on PVC jacketing and preformed fitting covers closures are not allowed for below ambient vapor barrier applications.

3.7 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668/D1668M, Type III (resin treated) and Type I (asphalt or white resin treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079H, Type II, Class 1.

C. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

D. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

E. PVC fitting cover: Fed. Spec L-P-535E, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 10 to 121 degrees C (50 to 250 degrees F). Below 10 degrees C (50 degrees F) and above 121 degrees C (250 degrees F) provide mitered pipe insulation of the same type as insulating straight pipe. Provide double layer insert. Provide vapor barrier pressure sensitive tape matching the color of the PVC jacket.

3.8 FIRESTOPPING MATERIAL

Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

3.9 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

PART 4 - EXECUTION

4.1 GENERAL REQUIREMENTS

A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Contracting Officer’s Representative (COR) for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).

D. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 15 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

E. Install vapor stops with operating temperature 15 degrees C (60 degrees F) and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths every 4.6 to 6.1 meters (approx. 15 to 20 feet) of pipe insulation. The annular space between the pipe and pipe insulation of approx. 25 mm (1 inch) in length at every vapor stop shall be sealed with appropriate vapor barrier sealant. Bio-based materials shall be utilized when possible.

F. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment. Do not insulate over equipment nameplate data.

G. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer coating (caution about coating's maximum temperature limit) or jacket material.

H. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

I. Plumbing work not to be insulated unless otherwise noted:
   1. Piping and valves of fire protection system.
   2. Chromium plated brass piping.
   3. Water piping in contact with earth.
   4. Distilled water piping.

J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness. Bio-based materials shall be utilized when possible.

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

L. Firestop Pipe insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07 84 00, FIRESTOPPING.
   2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
      a. Pipe risers through floors
      b. Pipe chase walls and floors
      c. Smoke partitions
      d. Fire partitions
      e. Hourly rated walls

M. Provide vapor barrier systems as follows:
   1. All piping exposed to outdoor weather.
   2. All interior piping conveying fluids below ambient air temperature or inin high humidity locations.

N. Provide metal jackets over insulation as follows:
   1. All plumbing piping exposed to outdoor weather.
   2. Piping exposed in building, within 1829 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets except for cold pipe or tubing applications. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
   3. A 50 mm (2 inch) jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

O. Provide PVC jackets over insulation as follows:
   1. Piping exposed in building, within 1829 mm (6 feet) of the floor, on piping that is not precluded in previous sections.
   2. A 50 mm (2 inch) jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

4.2 INSULATION INSTALLATION

A. Molded Mineral Fiber Pipe and Tubing Covering:
   1. Fit insulation to pipe, aligning all longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation except for cold piping. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic.

Provide cellar glass inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

2. Contractor's options for fitting, flange and valve insulation:
   a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 15 degrees C (60 degrees F) or more.
   b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts surface temperature of above 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Provide mitered preformed insulation of the same type as the installed straight pipe insulation for pipe temperatures below 4 degrees C (40 degrees F). Secure first layer of mineral fiber insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
   c. Factory preformed, ASTM C547 or fabricated mitered sections, joined with adhesive or (hot only) wired in place. (Bio-based materials shall be utilized when possible.) For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 15 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
   d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

B. Cellular Glass Insulation:
   1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.

4.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
B. Components provided under this section of the specification will be tested as part of a larger system.

4.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)

		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	**Insulation Material**	**Less than 25 (1)**	**25 – 32 (1 – 1¼)**	**38 – 75 (1½ - 3)**	**100 (4) and Greater**
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Cellular Glass Thermal	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-15 degrees C (40-60 degrees F) Domestic Cold Water	Cellular Glass Thermal	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

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SECTION 22 08 00
COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 22.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 22, is required in cooperation with the VA and the Commissioning Agent.

B. The Plumbing systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. . All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

----- END -----

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 07 84 00, FIRESTOPPING.

F. Section 07 92 00, JOINT SEALANTS.

G. Section 09 91 00, PAINTING.

H. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

J. Section 22 07 11, PLUMBING INSULATION.

K. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

A13.1 .....Scheme for Identification of Piping Systems

B16.3 .....Malleable Iron Threaded Fittings: Classes 150 and 300

B16.9 .....Factory-Made Wrought Buttwelding Fittings

B16.11 .....Forged Fittings, Socket-Welding and Threaded

B16.12 .....Cast Iron Threaded Drainage Fittings

B16.15 .....Cast Copper Alloy Threaded Fittings: Classes 125 and 250

B16.18 .....Cast Copper Alloy Solder Joint Pressure Fittings

B16.22 .....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24 .....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME Boiler and Pressure Vessel Code -

BPVC Section IX.....Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1010 .....Performance Requirements for Water Hammer Arresters

D. American Society for Testing and Materials (ASTM):

A47/A47M).....Standard Specification for Ferritic Malleable Iron Castings

A53/A53M.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A183 .....Standard Specification for Carbon Steel Track Bolts and Nuts

A269/A269M.....Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A312/A312M.....Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A403/A403M.....Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

A536-1984.....Standard Specification for Ductile Iron Castings

A733 .....Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32 .....Standard Specification for Solder Metal

B43 .....Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B61 .....Standard Specification for Steam or Valve Bronze Castings

B62 .....Standard Specification for Composition Bronze or Ounce Metal Castings

B75/B75M .....Standard Specification for Seamless Copper Tube

B88 ..... Standard Specification for Seamless Copper Water Tube

B584 ..... Standard Specification for Copper Alloy Sand Castings for General Applications

B687 ..... Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

C919 ..... Standard Practice for Use of Sealants in Acoustical Applications

D1785 ..... Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2000 ..... Standard Classification System for Rubber Products in Automotive Applications

D2564 ..... Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

D2657 ..... Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

D2855 ..... Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

D4101 ..... Standard Specification for Polypropylene Injection and Extrusion Materials

E1120 ..... Standard Specification for Liquid Chlorine

E1229 ..... Standard Specification for Calcium Hypochlorite

F2389 ..... Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

F2620 ..... Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

F2769 ..... Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. American Water Works Association (AWWA):

C110 ..... Ductile-Iron and Gray-Iron Fittings

C151 ..... Ductile Iron Pipe, Centrifugally Cast

C153 ..... Ductile-Iron Compact Fittings

C203 ..... Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

C213 ..... Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

C651 ..... Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8M/A5.8-AMD1 ..... Specification for Filler Metals for Brazing and Braze Welding

G. International Code Council (ICC):

IPC ..... International Plumbing Code

H. Manufacturers Specification Society (MSS):

SP-58 ..... Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

SP-72 ..... Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-110 ..... Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF International (NSF):

14 ..... Plastics Piping System Components and Related Materials

61 ..... Drinking Water System Components – Health Effects

372 ..... Drinking Water System Components – Lead Content

J. Plumbing and Drainage Institute (PDI):

PDI-WH 201..... Water Hammer Arrestors

K. Department of Veterans Affairs:

H-18-8 ..... Seismic Design Handbook

H-18-10 ..... Plumbing Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. All items listed in Part 2 - Products.
D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.
B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.
D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.6 SPARE PARTS

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be via electronic file transfer. One operation and maintenance manual shall be inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included

in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version2023 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule40 shall be used.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.

2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kPa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
3. Mechanical press-connect fittings for copper pipe and tube **<u>are prohibited</u>**. See Plumbing Design Manual for additional information.
4. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.
5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Fittings for Stainless Steel:
1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.
2. Grooved fittings, stainless steel, Type 316, Schedule40 , conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.
3. Reverse Osmosis (RO) Water Piping:
   a. Low Pressure Feed, Reject and Recycle Piping: Less than or equal to 520 kPa (75 psig): ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
   b. RO Product Tubing from each Membrane Housing: ASTM D1785, Schedule 80 PVC, ASTM D2855 socket welded and flanged.
   c. Low Pressure Control and Pressure Gage Tubing: Polyethylene.

d. High Pressure Reject and Recycle Piping: Greater than 520 kPa (75 psig): ASTM A269/A269M, Type 304 schedule 10 stainless steel with butt welded joints.

2.3 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment, and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. Pipe: ASTM B43, standard weight.
   2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
   3. Nipples: ASTM B687, Chromium-plated.
   4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 TRAP PRIMER WATER PIPING

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.

B. Fittings: Bronze castings conforming to ASME B16.18 Solder joints.

C. Solder: ASTM B32 alloy type Sb5. Provide non-corrosive flux.

2.5 STRAINERS

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between pipe of dissimilar metals.

2.7 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access

shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:

1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
   a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
   b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
   c. Floor, Wall and Ceiling Plates, Supports, Hangers:
      1) Solid or split un-plated cast iron.
      2) All plates shall be provided with set screws.
      3) Pipe Hangers: Height adjustable clevis type.
      4) Adjustable Floor Rests and Base Flanges: Steel.
      5) Concrete Inserts: "Universal" or continuous slotted type.
      6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.

7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
8) Rollers: Cast iron.
9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
10) Hangers and supports utilized with insulated pipe and tubing shall have 180-degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the firestopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.

B. Domestic Water piping shall conform to the following:

1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot and cold water circulating lines with no traps.
2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.

C. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

D. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic water pressure booster system.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

G. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.

H. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

I. Section 26 29 11, MOTOR CONTROLLERS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

ASME Boiler and Pressure Code -

BPVC Section VIII-1.....Rules for Construction of Pressure Vessels, Division 1

BPVC Section VIII-2.....Rules for Construction of Pressure Vessels, Division 2-Alternative Rules

C. American Society for Testing and Materials (ASTM):

A48/A48M.....Standard Specification for Gray Iron Castings

B584 .....Standard Specification for Copper Alloy Sand Castings for General Applications

D. International Code Council (ICC)

IPC .....International Plumbing Code

E. National Electrical Manufacturers Association (NEMA):

ICS 6.....Industrial Control and Systems: Enclosures

250 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

F. NSF International (NSF)

61 .....Drinking Water System Components – Health Effects

372 .....Drinking Water System Components – Lead Content

G. Underwriters' Laboratories, Inc. (UL):

508 .....Standards for Industrial Control Equipment

778 .....Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 23, DOMESTIC WATER PUMPS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pump:
   a. Manufacturer and model.
   b. Operating speed.
   c. Capacity.
   d. Characteristic performance curves.
2. Motor:
   a. Manufacturer
   b. Speed.

c. Current Characteristics.

d. Efficiency.

3. Tank:

a. Manufacturer and model.

b. Capacity

4. Drive: Information in accordance with Section 26 29 11, MOTOR CONTROLLERS.

D. Certificate of shop test for domestic water booster system. Provide certified performance curves.

E. Certified copies of all the factory and construction site test data sheets and reports.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

G. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

H. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. General:

1. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2. Design Criteria:

a. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.

b. Head-capacity curves shall slope up to maximum head at shut-off. Select pumps near the midrange of the curve, and near the point of maximum efficiency, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).

c. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve, including in a parallel or series pumping installation with one pump in operation.
d. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
e. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
f. Test all pumps before shipment. The manufacturer shall certify all pump ratings.
g. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.

B. Domestic Water Pressure Booster System:
1. Components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer.
2. Shop Test: Water booster unit and its component parts shall undergo a thorough electric and hydraulic operating test prior to shipment. Tests shall include a system operating flow test from zero to 100 percent of design flow rate under specified suction and system pressure conditions. Certified performance curves shall be furnished.

C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version as well as a physical copy inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance

manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2015 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

Material or equipment containing a weighted average of greater than 0.25 percent lead shall be prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

2.2 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

A. General: Provide a factory prefabricated, prewired and pretested multi-stage pumping system including ECM motors, pressure regulating valves with integral check valves, pressure transducers, vibration pads, emergency switches, duplex flow switches, power and control panels, suction and discharge manifolds, butterfly isolation valves, ball drain valves, bypass loops with appropriate valves and check valves, low pressure cut-off switches, hydropneumatic tanks and accessories. All components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer. All components shall be factory installed on a common structural steel skid and shall be completely tested in the factory before shipment. Manufacturer shall assume "unit responsibility" to ensure that all components effectively interface to execute the operation of the designed system.

B. System Operation and Configuration:
   1. System shall automatically maintain constant system pressureas scheduled on drawings at the outlet of the pressure control valve and hydropneumatic tank check valve at all times. Suction pressure as per the drawings 7 psig) to 15 psig).

C. Centrifugal Pump: Pumps shall be single stage, in-line pump with variable speed drive motor, low pressure cut-off switches and bypass loops with ball, gate, and check valves as indicated on the Contract Drawings.
   1. Impellers: ASTM B584 Cast bronze, radially or vertically split keyed to shaft and secured by a locking cap-screw. Each impeller shall be statically and dynamically balanced prior to assembly in pump casing. Provide replaceable bronze casing wear rings.
   2. Pump shaft: Steel, with replaceable bronze shaft sleeve completely covering the wetted area of the shaft under the seal.
   3. Lubrication: Water lubricated type pump.
   4. Pump Casing: ASTM A48/A48M CL20 Cast iron suitable for 1200 kPa (175 psig). Pump volute shall be supplied with vent and drain tappings. Connections shall be female NPT. The casing shall be O-ring sealed to the seal housing.
   5. Seal: Mechanical general purpose type, with sleeve mounting. Seal shall be rated at 1200 kPa (175 psig) maximum.
   6. Adjustable Spacer Coupling: Removable type required so that pump seal can be replaced without disturbing motor.
   7. Motor: Solid shaft motors balanced to 0.22 mm (0.0085 inch) vibration amplitude shall be operated at any point on the pump head curve without overloading the motor. Conform to NEMA Type 2.

D. Pressure Regulating Valves: System pressure shall be maintained by pilot-operated, diaphragm type pressure regulating valves, rated at 2070 kPa (300 psig) minimum, one for each pump. Valves shall be piloted to control system pressure and to cause the valve to act as a non-slam check valve. Pilot shall be rated at 1200 kPa (175 psig) minimum.

E. Hydropneumatic Tank: Bladder type, hydropneumatic, designed and constructed in accordance with requirements of the ASME Pressure Vessel Code and stamped with appropriate symbol. Tank shall include pre-pressurized, sealed-in air cushion which shall accommodate pressure increases and expanded water volumes in the tank. Tank shall include butyl rubber or poly-

propylene liner in lower, or water side of chamber. Minimum working pressure of tank shall be 1200 kPa (175 psig). Unit shall be designed and manufactured for domestic water applications. Insulate tank as specified. Check valve at hydropneumatic tank shall include small orifice for undue loading.

F. Power and Control Panel: Class "A" shadow box double NEMA 1 enclosure, UL labeled, bonderized double prime coated with baked enamel finish:
   1. Fused disconnect switches with external operating handles.
   2. Magnetic contactor for each motor with HOA switch.
   3. Door interlock.
   4. Thermal overload protection relay for each motor, three leg type.
   5. Running light for each motor.
   6. Power light for each motor.
   7. Control transformer, switch, circuit breaker, light.
   8. Lead pump failure protection.

G. Motor and Starter: Maximum 104 degrees F ambient temperature rise, drip-proof type motor, ball bearings, voltage and phase as shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motor shall be of such capacity that brake horsepower required by driven equipment at normal rated capacity will not exceed nameplate rating of the motor. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Provide each motor with automatic, fully enclosed, magnetic starter of type specified in Section 26 29 11, MOTOR CONTROLLERS.

H. Instrumentation: All instrumentation shall be factory installed and shall include the following 115 mm (4-1/2 inch) dial gages with shut-off cock.
   1. Pump pressure gage for each pump.
   2. System pressure gage.
   3. Suction pressure gage.

I. Operating and Emergency Controls:
   1. The pump station shall receive a 4-20mA signal from each pressure transducer, as provided by the pumping station manufacturer. A pressure transducer signal shall be provided for each pump controller. The differential pressure transducers shall monitor system discharge pressure versus suction line pressure and provide an analog signal 4-20mA to the pump

control software, and allow the variable speed pump controller, to provide a variable Volts/Hz output to the motor. Once the pressure drops below the set system pressure, the pump shall start and provide system pressure (as determined by the station operator or program). The sequence of the pumps shall be field adjustable, and completely automatic without additional panels or alternator controls. Special type motors shall not be allowed. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Pump assignments shall alternate as described below. All program settings shall be based on centrifugal pump language and centrifugal pumps. Program settings shall be field adjustable to provide onsite adjustments. When the system experiences low demand, the variable speed pump controllers shall reduce the speed of each pump, until demand has stopped. Pump controllers shall stop each pump at zero demand, without the use of external switches or controls.

2. The pump logic controller shall provide the following standard user-selectable features:
   a. Low Suction Pressure Alarm and Cut Out
   b. High Suction Pressure Alarm and Cut Out
   c. Low System Pressure Alarm
   d. High System Pressure Alarm and Cut Out
   e. Low Level Alarm and Cut Out
   f. No-Flow Shut Down
   g. Audible/Visible alarm with push to silence feature
   h. Overload Failure Alarm
   i. Pump Failure Alarm
   j. Pump operating order assignments
   k. Minimum run timers to prevent short cycle operation.
3. Provide auxiliary contacts for remote communication with the BAS, including the following input/output points:
   a. Domestic water supply pressure (analog input to BAS)
   b. Alarm condition activated (binary input to BAS)
   c. Run status of lead pump (binary input to BAS)
   d. Run status of lag pump (binary input to BAS)
   e. Run status of stand-by pump (binary input to BAS)

J. Factory Test: The booster system and its component parts shall undergo a complete operation flow test from zero to 100 percent design flow rate under the specified suction and net system pressure conditions. The system certification shall include copies of the test and test data as performed in the factory prior to shipment. Performance test certifications should be placed inside the system control panel and two extra copies shall be provided to the COR with the installation manual.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.2 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 10 hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.

G. Section 07 92 00, JOINT SEALANTS: Sealant products.

H. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.

I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.

J. Section 22 07 11, PLUMBING INSULATION.

K. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

L. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.3 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

A13.1 ..... Identification of Piping Systems

A112.36.2M..... Cleanouts

A112.6.3 ..... Floor and Trench Drains

B1.20.1 ..... Pipe Threads, General Purpose (Inch)

B16.1 ..... Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

B16.4 ..... Grey Iron Threaded Fittings Classes 125 and 250

B16.15 ..... Cast Copper Alloy Threaded Fittings, Classes 125 and 250

B16.18 ..... Cast Copper Alloy Solder Joint Pressure Fittings

B16.21 ..... Nonmetallic Flat Gaskets for Pipe Flanges

B16.22 ..... Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.23 ..... Cast Copper Alloy Solder Joint Drainage Fittings: DWV

B16.24 ..... Cast Copper Alloy Pipe Flanges and Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B16.29 ..... Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV

B16.39 ..... Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

B18.2.1 ..... Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. American Society of Sanitary Engineers (ASSE):

1001 ..... Performance Requirements for Atmospheric Type Vacuum Breakers

1018 ..... Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied

1044 ..... Performance Requirements for Trap Seal Primer Devices – Drainage Types and Electronic Design Types

1079 ..... Performance Requirements for Dielectric Pipe Unions

D. American Society for Testing and Materials (ASTM):

A53/A53M..... Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless

A74 ..... Standard Specification for Cast Iron Soil Pipe and Fittings

A888 ..... Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

B32 ..... Standard Specification for Solder Metal

B43 ..... Standard Specification for Seamless Red Brass Pipe, Standard Sizes

B88 ..... Standard Specification for Seamless Copper Water Tube

B306 ..... Standard Specification for Copper Drainage Tube (DWV)

B687 ..... Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples

B813 ..... Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

B828 ..... Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

C564 ..... Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D2321 ..... Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2564 ..... Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2665 ..... Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

D2855 ..... Standard Practice for Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) CPVCP Pipe and Piping Components with Tapered Sockets

D5926 ..... Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

F402 ..... Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F477 .....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F1545 .....Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

E. Cast Iron Soil Pipe Institute (CISPI):

.....Cast Iron Soil Pipe and Fittings Handbook

301 .....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

310 .....Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

F. Copper Development Association, Inc. (CDA):

A4015-14/19 .....Copper Tube Handbook

G. International Code Council (ICC):

IPC .....International Plumbing Code

H. Manufacturers Standardization Society (MSS):

SP-123 .....Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube

I. National Fire Protection Association (NFPA):

70 .....National Electrical Code (NEC)

J. Underwriters' Laboratories, Inc. (UL):

508-99 .....Standard For Industrial Control Equipment

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, materials, applications, standard compliance, and size.

1. Piping.

2. Floor Drains.
3. Cleanouts.
4. Trap Seal Protection.
5. Penetration Sleeves.
6. Pipe Fittings.
7. Traps.
8. Exposed Piping and Fittings.

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's bio-based Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

A. Cast iron waste, drain, and vent pipe and fittings.

1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
   a. Pipe buried in or in contact with earth.

b. Sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.

c. Interior waste and vent piping above grade.

2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.

B. Copper Tube, (DWV):

1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

C. Polyvinyl Chloride (PVC)

1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is less than 60 degrees C (140 degrees F).
2. PVC piping and fittings shall NOT be used for the following applications:

   a. Waste collected from steam condensate drains.

   b. Spaces such as mechanical equipment rooms, kitchens, Sterile Processing Services, sterilizer areas, and areas designated for sleep.

   c. Vertical waste and soil stacks serving more than two floors.

   d. Exposed in mechanical equipment rooms.

   e. Exposed inside of ceiling return plenums.

3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.

4. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.2 PUMP DISCHARGE PIPING

A. Galvanized steel pump discharge pipe and fittings:
   1. Galvanized steel pipe shall be Schedule 40 weight class conforming to ASTM A53/A53M, with square cut grooved or threaded ends to match joining method.
   2. Fittings shall be Class 125, gray-iron threaded fittings conforming to ASME B16.4.
   3. Unions shall be Class 150 hexagonal-stock body with ball and socket, metal to metal, bronze seating surface, malleable iron conforming to ASME B16.39 with female threaded ends.
   4. Flanges shall be Class 125 cast iron conforming to ASME B16.1.
      a. Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
      b. Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.

B. Copper pump discharge pipe and fittings:
   1. Copper tube shall be hard drawn Type L conforming to ASTM B88.
   2. Fittings shall be cast copper alloy conforming to ASME B16.18 or wrought copper conforming to ASME B16.22 with solder joint ends.
   3. Unions shall be copper alloy, hexagonal stock body with ball and socket, metal to metal seating surface conforming to MSS SP-123 with female solder-joint.
   4. Flanges shall be Class 150, cast copper conforming to ASME B16.24 with solder-joint end.
      a. Flange gaskets shall be full face, flat nonmetallic, asbestos free conforming to ASME B16.21.
      b. Flange nuts and bolts shall be carbon steel conforming to ASME B18.2.1.
   5. Solder shall be lead free, water flushable flux conforming to ASTM B32 and ASTM B813.

2.3 EXPOSED WASTE PIPING

A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
   1. The Pipe shall meet ASTM B43, regular weight.
   2. The Fittings shall conform to ASME B16.15ASTM D2665.
   3. Nipples shall conform to ASTM B687, Chromium-plated.

4. Unions shall be brass or bronze with chrome finish. Unions2-1/2 inches and larger shall be flange type with approved gaskets.

B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.4 SPECIALTY PIPE FITTINGS

A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.
3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of125 psig at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.

C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of150 psig. The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of300 psig at225 degrees F. The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.5 CLEANOUTS

A. Cleanouts shall be the same size as the pipe, up to4 inches; and not less than4 inches for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of24 inches shall be provided for clearing a clogged sanitary line.

B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated in the contract document and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of6 by 6 inches shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.6 FLOOR DRAINS

A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening shall not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 1.1 to 1.8 Kg (2.5 to 4 lbs.) flashing

membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.

B. Type M (FD-M) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension for indirect waste. Cut-out grate below funnel. Minimum dimensions as follows:
   1. Area of strainer and collar – 23,000 square mm (36 square inches).
   2. Height of funnel – 95 mm (3-3/4 inches).
   3. Diameter of lower portion of funnel – 50 mm (2 inches).
   4. Diameter of top portion of funnel – 100 mm (4 inches).
   5. Provide paper collars for construction purposes.

2.7 TRAPS

Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are prohibited on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.8 PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

A. Trap Primer (TP-2): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 861 kPa (125 psig) and conforming to standard ASSE 1018.
   1. The inlet and outlet connections shall be 15 mm or DN15 (NPS 1/2 inch)
   2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
   3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
   4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
   5. The manifold shall be omitted when serving only one trap.

2.9 PENETRATION SLEEVES

A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that shall extend 50

mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. The piping shall be installed above accessible ceilings where possible.

F. The piping shall be installed to permit valve servicing or operation.

G. The piping shall be installed free of sags and bends.

H. Seismic restraint shall be installed where required by code.

I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow greater than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.

K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".

M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

N. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 JOINT CONSTRUCTION

A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
   2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

F. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendices.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.

C. Horizontal piping and tubing shall be supported within12 inches of each fitting or coupling.

D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. NPS 1-1/2 inch to NPS 2 inch: 60 incheswith3/8 inch rod.
2. NPS 3 inch: 60 inches with1/2 inch rod.
3. NPS 4 inch to NPS 5 inch:60 incheswith5/8 inch rod.
4. NPS 6 inch to NPS 8 inch: 60 incheswith3/4 inch rod.
5. NPS 10 inch to NPS 12 inch: 60 inchwith7/8 inch rod.
6. The maximum spacing for plastic pipe shall be 4 feet.

E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than15 feet.

F. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

G. Miscellaneous materials shall be provided as specified, required, directed or as noted in the contract documents for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

I. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

J. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.5 TESTS

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 34 kPa (5 psig) gauge shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gauge shall be used for the air test.

3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
   a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
   b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

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SECTION 22 67 19.16
REVERSE-OSMOSIS WATER EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide complete industrial-type packaged reverse osmosis (RO) water treatment system producing high purity water by removal of dissolved minerals, bacteria, particles and organic impurities. Designed for continuous automatic operation. The system shall include pre-filter, product storage tank and all devices necessary for fully operational system. RO system operation shall be controlled by the water level in the product storage tank.

B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.

F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Systems for service other than boiler plant make-up water.

G. Section 22 07 11, PLUMBING INSULATION.

H. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATION.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by their basic designation only.

B. American Society of Mechanical Engineers (ASME):

B40.100 ..... Pressure Gauges and Gauge Attachments

C. ASTM International (ASTM):

A269/A269M.....Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

D1785.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D. American Water Works Association (AWWA):

B300 .....Hypochlorites

B301 .....Liquid Chlorine

C651 .....Disinfecting Water Mains

E. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2001, R2006).....Industrial Control and Systems Enclosures

F. National Fire Protection Association (NFPA):

70 .....National Electrical Code

G. Department of Health and Human Services, Food and Drug Administration (FDA):

CFR 21, Chapter 1, Part 175.300, Resinous and Polymeric Coatings

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 67 19.16, REVERSE-OSMOSIS WATER EQUIPMENT”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Catalog cuts, complete description and specifications of all equipment and accessories.
2. Accessories including filters, product storage tank, pressure gages and test kit.
3. Performance data including normal and maximum flow and pressure drop. Certification that required performance shall be achieved.
4. Piping.

D. Complete detailed layout, setting, arrangement, and installation drawings including. Drawings shall also show all parts of the apparatus including relative positions, dimensions, and sizes and general arrangement of connecting piping.

A. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS./

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. Manufacturer shall have been engaged in the manufacture of RO systems as a primary product for at least ten years. The ten year requirement supersedes any conflicting requirement in other parts of the project specification.

B. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.6 PROJECT CONDITIONS

A. Influent Water Analysis:

Maximum Silt Density Index (SDI) Rating _____

Turbidity, NTU _____

Maximum Free Chlorine and/or Chloramine _____ppm

Color: _____

Maximum pH (continuous) _____

Minimum pH (continuous) _____

Maximum pH (cleaning-30 minutes) _____

Minimum pH (cleaning–30 minutes) _____

Confirm the analysis with current samples and tests.

B. Design Parameters:

Normal System Flow:5gpm

Maximum System Flow:gpm

Daily Water Usage:24gallons per day

Daily Hours of Water Demand: Varies with humidification needs.

Operating Temperature Range:40 to 100 degrees F

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version as well as a physical copy inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2015 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 - **PRODUCTS**

2.1 RO SYSTEM

A. Packaged automatic RO system mounted on steel frame, designed for project conditions. Equipment arranged on the frame to allow easy access for operating, maintenance and repair.

Unit shall include RO membrane, pressure vessels, pre-filtration system, high pressure pump and all required piping, wiring and controls for a fully operational system.

B. Performance Requirements:
   1. Membrane reject ratio: 98 percent minimum. TDS of product is 2 percent maximum of input TDS.
   2. Capture rate: 75 percent minimum. Maximum amount of water to drain 25 percent of input.

C. RO Membrane Elements: Thin-film composite with fiberglass reinforced polyester (FRP) over-wrap, anti-telescoping device, u-cup brine seal. The design salt rejection shall be 98 percent based on 2000 ppm water at225 psig at77 degrees F.

D. RO Element Housings: Type 304 stainless steel with PVC end caps held in place with stainless steel bands. Each housing assembly complete with one set of O-rings and O-ring lubricant. (Bio-based materials shall be utilized when possible.)

E. High Pressure Pumps and Motors: Single multistage high efficiency centrifugal type with Type 304 stainless steel casing, shaft, impellers. Tungsten carbide and ceramic shaft seals. Cast iron frame with flanged piping connections. Premium efficiency TEFC motor selected to be non-overloading on the entire performance curve.

F. Manual Valves:
   1. Pump Throttle Valve: Type 316 stainless steel ball valve, socket welded.
   2. Concentrate Throttle Valve, Recycle Throttle Valve: In-line needle style, stainless steel, rated for300 psig minimum.
   3. Inlet Isolation Valve, Product and Concentrate Check Valves: PVC with EPDM seats and seals.
   4. Feedwater Sample Valve, Product Water Sample Valve: PVC plug valve with EPDM seats and seals.
   5. High Pressure Sample Valve: Type 316 stainless steel plug valve.

G. Automatic Valves:
   1. Automatic Inlet Shut Off Valve: Solenoid type, diaphragm actuated, normally closed, constructed of glass-filled Noryl thermoplastic.
   2. Automatic Membrane Flush Valve: Provide for purging the membranes with fresh water upon machine shut down.

H. Piping:

1. Low Pressure Feed, Reject and Recycle Piping75 psig and under: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
2. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
3. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
4. High Pressure Reject and Recycle Pipingabove 75 psig: ASTM A269/A269M, Type 304 Schedule 10 stainless steel with butt welded joints.
5. High Pressure Control and Pressure Gage Tubing:1000 psig burst nylon.

I. Controls:

1. Electronic DDC controller providing automatic control for all operating functions. Motor starter panel. All in FRP enclosures rated NEMA 4. All wiring factory-installed and tested. Comply with Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES and NFPA 70.
2. Autoflush indicator and control to flush RO concentrate at shut down or at predetermined intervals.
3. Warning Alarms: Low quality product, low feed pressure, high feed temperature. Connect to BAS system.
4. Automatic Shutdowns and Alarms: Low feed pressure, low product quality, pretreatment out of service, storage tank full.
5. Status Indicators: Low feed pressure, low quality, flow alarm, high feed water temperature, product divert to drain valve open, pretreatment lockout, storage tank full.
6. Low and High pressure safety switches.
7. Tank water level control switches.
8. Pump Motor Starter: Comply with Section 26 29 11, MOTOR CONTROLLERS.
9. Miscellaneous Controls: Elapsed run time indicator, alarm horn, chemical pump receptacles, convenience receptacles, minimum 8 auxiliary contacts 2DI, 2DO, 2AI, 2AO.

J. Instrumentation and Displays:

1. All instrumentation readouts panel-mounted in FRP enclosures rated NEMA 4. All factory wiring. Comply with NFPA 70.
2. Digital flow indicators for, product, reject, recycle.
3. Pressure gages for inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product.

4. Conductivity indicator measuring product quality with digital displays, alarm relays and automatic temperature compensation.
5. Conductivity probe mounted in the RO product.

K. Skid and Frame Assembly: RO machine shall be built on a skid and frame constructed of welded structural carbon steel. The entire surface shall be sand-blasted and coated with high solids epoxy coating. Bio-based materials shall be utilized when possible.

L. Reassembly: Unit shall be shipped to the site completely assembled and tested. If units or sections are to be disassembled at the site to allow for installation in a limited space, the unit shall be reassembled and tested for intended operation by a factory authorized technical representative.

2.2 PRE-FILTER

A. Single multi-media filter sized for the RO machine inlet flow rate. Filter designed for suspended solids removal down to 10 microns and automatic backwash cycle.

B. Media Tank: FRP designed for150 psig. Pre-piped internal backwash distributor and filtered water collector.

C. Filter Media: Top layer of anthracite, middle layer of silica sand, bottom layer of multi-grade garnet. Install filter media at job site.

D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

E. Replacement Filter Media: Provide elements for one complete replacement.

2.3 ACTIVATED CARBON FILTER

A. Single filter sized for the RO machine inlet flow rate. Designed to remove chlorine and prevent RO membrane damage.

B. Media Tank: FRP designed for150 psig. Pre-piped internal backwash distributor and filtered water collector.

C. Filter Media: 12 x 40 mesh bituminous coal-based activated carbon. Install media at job site.

D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

2.4 RO WATER STORAGE TANK

A. Free-standing, closed-top, flat-bottom, 11.59 cubic feet) total volume. Top access manway, PVC bulkhead fittings for high and low level alarm switches, RO permeate inlet, RO permeate discharge and drain. Install 0.2 micron tank vent filter at the top head. Vented to atmosphere.

B. Materials of Construction: Linear polyethylene in one piece.

C. Tank Water Level Control: Adjustable float switch that signal starting and stopping RO pump. High and low level alarm switches.

2.5 PRESSURE GAGES

ASME B40.100, Grade A, 1 percent accuracy,4-1/2 inches diameter, all metal case, bottom connected. White dials, black hands, graduated from0 to 100 psig and identity labeled.

2.6 WATER TESTING EQUIPMENT

A. Furnish water testing equipment in a portable cabinet specially made for the installed equipment. Include sufficient materials for 6 months of normal testing procedures.

B. Silt Density Index (SDI) apparatus to measure degree of suspended solids feeding the RO membranes. Include pressure regulator, pressure gage, filter holder,20 ounce beaker, sample valve, tubing and 0.45 micron filter papers.

C. Test kit to measure total water hardness, total iron, free chlorine, pH.

PART 3 - EXECUTION

3.1 REQUIRED TECHNICAL SERVICES

Provide services of a qualified manufacturer's representative to check complete installation for conformance to manufacturer's recommendations, put system into service, make all adjustments required for full conformance to design and specified requirements, and perform all demonstrations and tests.

3.2 FLUSHING AND DISINFECTING

A. Flush and disinfect new water lines and RO system and tank interiors in accordance with AWWA C651.

B. Material:

1. Liquid chlorine: AWWA B301.
2. Hypochlorite: AWWA B300.

3.3 STARTUP AND TESTING

A. Operating: Tests shall be run in presence of COR.

B. Procedure:

1. Operate RO system at constant maximum required capacity for one hour after demineralized RO product water is produced. When necessary, waste product water to sewer to maintain above flow rate. Product water production shall begin when a sample shows that demineralization complies with requirements.
2. Demonstrate all features of the control system including diagnostics and flow and cycle indications.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

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SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23, HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

B. Definitions:

1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
2. Exterior: Piping, ductwork, and equipment exposed to weather be it temperature, humidity, precipitation, wind, or solar radiation.

C. Abbreviations/Acronyms:

1. ac: Alternating Current
2. AC: Air Conditioning
3. ACU: Air Conditioning Unit
4. ACR: Air Conditioning and Refrigeration
5. AI: Analog Input
6. AISI: American Iron and Steel Institute
7. AO: Analog Output
8. ASJ: All Service Jacket
9. AWG: American Wire Gauge
10. BACnet: Building Automation and Control Networking Protocol
11. BAS: Building Automation System
12. bhp: Brake Horsepower
13. Btu: British Thermal Unit
14. Btu/h: British Thermal Unit Per Hour
15. CDA: Copper Development Association
16. C: Celsius
17. CD: Compact Disk
18. CFM: Cubic Foot Per Minute
19. CH: Chilled Water Supply
20. CHR: Chilled Water Return
21. COR: Contracting Officer’s Representative

22. CPVC: Chlorinated Polyvinyl Chloride
23. CRS: Corrosion Resistant Steel
24. CW: Cold Water
25. CxA: Commissioning Agent
26. DDC: Direct Digital Control
27. DI: Digital Input
28. DO: Digital Output
29. DVD: Digital Video Disc
30. DN: Diameter Nominal
31. DWV: Drainage, Waste and Vent
32. EPDM: Ethylene Propylene Diene Monomer
33. EPT: Ethylene Propylene Terpolymer
34. ETO: Ethylene Oxide
35. F: Fahrenheit
36. FAR: Federal Acquisition Regulations
37. FD: Floor Drain
38. FED: Federal
39. FOS: Fuel Oil Supply
40. FOR: Fuel Oil Return
41. GC: Chilled Glycol Water Supply
42. GCR: Chilled Glycol Water Return
43. gpm: Gallons Per Minute
44. HDPE: High Density Polyethylene
45. hp: Horsepower
46. HW: Hot Water
47. HWH: Hot Water Heating Supply
48. HWHR: Hot Water Heating Return
49. ID: Inside Diameter
50. IPS: Iron Pipe Size
51. kg: Kilogram
52. klb: 1000 lb
53. lb: Pound

54. lb/hr: Pounds Per Hour
55. L/s: Liters Per Second
56. L/min: Liters Per Minute
57. LPS: Low Pressure Steam (103 kPa (15 psig) and below)
58. LPR: Low Pressure Steam Condensate Gravity Return
59. MAX: Maximum
60. MBtu/h: 1000 Btu/h
61. MBtu: 1000 Btu
62. m: Meter
63. MFG: Manufacturer
64. mg: Milligram
65. mg/L: Milligrams Per Liter
66. MIN: Minimum
67. ml: Milliliter
68. mm: Millimeter
69. MPS: Medium Pressure Steam (110 kPa (16 psig) through 414 kPa (60 psig))
70. MPR: Medium Pressure Steam Condensate Return
71. NC: Normally Closed
72. NO: Normally Open
73. NPT: National Pipe Thread
74. NPS: Nominal Pipe Size
75. OD: Outside Diameter
76. OSD: Open Sight Drain
77. PLC: Programmable Logic Controllers
78. PP: Polypropylene
79. PPE: Personal Protection Equipment
80. ppb: Parts Per Billion
81. ppm: Parts Per Million
82. PRV: Pressure Reducing Valve \
83. psig: Pounds Per Square Inch Gauge
84. PTFE: Polytetrafluoroethylene
85. PVC: Polyvinyl Chloride

86. PVDC: Polyvinylidene Chloride Vapor Retarder Jacketing, White
87. PVDF: Polyvinylidene Fluoride
88. RH: Relative Humidity
89. RPM: Revolutions Per Minute
90. RS: Refrigerant Suction
91. SCFM: Standard Cubic Feet Per Minute
92. SPEC: Specification
93. STD: Standard
94. SWP: Steam Working Pressure
95. TAB: Testing, Adjusting, and Balancing
96. TEFC: Totally Enclosed Fan-Cooled
97. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
98. THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire
99. T/P: Temperature and Pressure
100. V: Volt
101. VAC: Vacuum
102. VA: Veterans Administration
103. VAC: Voltage in Alternating Current
104. VA CFM: VA Construction & Facilities Management
105. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service
106. VAMC: Veterans Administration Medical Center
107. VHA OCAMES: Veterans Health Administration – Office of Capital Asset Management Engineering and Support

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
F. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
G. Section 03 30 00, CAST-IN-PLACE CONCRETE.
H. Section 07 84 00, FIRESTOPPING.

I. Section 07 92 00, JOINT SEALANTS.

J. Section 09 91 00, PAINTING.

K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

L. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

M. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

N. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

O. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

P. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

Q. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

R. Section 23 36 00, AIR TERMINAL UNITS.

S. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

T. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

U. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

430 ..... Performance Rating of Central Station Air-Handling Unit Supply Fans

C. Air Movement and Control Association (AMCA):

410 ..... Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

D. American Society of Mechanical Engineers (ASME):

B31.1 ..... Power Piping

B31.9 ..... Building Services Piping

ASME Boiler and Pressure Vessel Code:

BPVC Section IXWelding, Brazing, and Fusing Qualifications

E. American Society for Testing and Materials (ASTM):

A36/A36M..... Standard Specification for Carbon Structural Steel

A575 .....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

F. Association for Rubber Products Manufacturers (ARPM):

IP-20 .....Specifications for Drives Using Classical V-Belts and Sheaves

IP-21 .....Specifications for Drives Using Double-V (Hexagonal) Belts

IP-24 .....Specifications for Drives Using Synchronous Belts

IP-27 .....Specifications for Drives Using Curvilinear Toothed Synchronous Belts

G. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.(MSS):

SP-58 .....Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application, and Installation

SP-127 .....Bracing for Piping Systems: Seismic–Wind–Dynamic Design, Selection, and Application

H. Military Specifications (MIL):

MIL-P-21035B.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)

I. National Fire Protection Association (NFPA):

70 .....National Electrical Code (NEC)

101 .....Life Safety Code

J. Department of Veterans Affairs (VA):

PG-18-10 .....Physical Security and Resiliency Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 05 11, COMMON WORK RESULTS FOR HVAC”, with applicable paragraph identification.

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor’s responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the

submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

D. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

E. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.

G. Samples: Samples will not be required, except for insulation or where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government's expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made.

H. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping

and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.

3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
   a. Mechanical equipment rooms.
   b. Hangers, inserts, supports, and bracing.
   c. Pipe sleeves.
   d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.

I. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit under the pertinent section rather than under this section.
   1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COR.
   2. Submit electric motor data and variable speed drive data with the driven equipment.
   3. Equipment and materials identification.
   4. Fire-stopping materials.
   5. Hangers, inserts, supports and bracing. Provide complete stress analysis for variable spring and constant support hangers.
   6. Wall, floor, and ceiling plates.

J. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan shall include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.

K. HVAC Maintenance Data and Operating Instructions:
   1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, paragraph INSTRUCTIONS for systems and equipment.
   2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
      a. Include complete list indicating all components of the systems.
      b. Include complete diagrams of the internal wiring for each item of equipment.

c. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply for equipment.

L. Provide copies of approved HVAC equipment submittals to the TAB and Commissioning Agent.

M. Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

N. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:

1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced onsite, as necessary.

2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls,

instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.

2. Refer to all other sections for quality assurance requirements for systems and equipment specified therein.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 23 sections shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Use of asbestos products or equipment or materials containing asbestos is prohibited.

E. HVAC Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore equipment operations within 4 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): fans, air handling units, chillers, cooling towers, control systems, pumps, critical instrumentation, computer workstation and programming.

F. HVAC Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:

1. HVAC mechanical systems welding shall meet ASME BPVC Section IX. Provide proof of current certification.
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.

G. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR with submittals. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material and removal by the Contractor and no additional cost or time to the Government.

H. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract documents to the COR for resolution. Provide written hard copies and computer files via approved file transfer site of manufacturer’s installation instructions to the COR with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the VA. Failure to furnish these recommendations is a cause for rejection of the material.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to, all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to the COR for resolution. Failure of the Contractor to resolve, or point out any issues will result in the Contractor correcting at no additional cost or time to the Government.
3. Complete coordination/shop drawings shall be required in accordance with paragraph SUBMITTALS. Construction work shall not start on any system until the coordination/shop drawings have been approved by VA.

4. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.

I. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.

J. Guaranty: Warranty of Construction, FAR Clause 52.246-21.

K. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specification section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

L. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
2. Large equipment such as boilers, chillers, cooling towers, fans, and air handling units if shipped on open trailer trucks shall be covered with shrink on plastics or water proof tarpaulins that provide protection from exposure to rain, road salts and other transit hazards. Protection shall be kept in place until equipment is moved into a building or installed as designed.
3. Repair damaged equipment in first class, new operating condition and appearance; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost or time to the Government.
4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

5. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
6. Protect plastic piping and tanks from ultraviolet light (sunlight).

B. Cleanliness of Piping and Equipment Systems:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Boilers shall be left clean following final internal inspection by Government, insurance representative, or inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version via electronic file transfer. One copy of operation and maintenance manuals shall be inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.

C. Phasing of Work: Comply with all requirements shown on contract documents. Contractor shall submit a complete detailed phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.

D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

E. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government,

inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 FACTORY ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Equipment and components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, shall be the same make and model. Exceptions must be approved by the VA, but may be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.4 ELECTRIC MOTORS

All material and equipment furnished, and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.5 VARIABLE SPEED MOTOR CONTROLLERS

A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL for specifications.

B. Coordinate variable speed motor controller communication protocol with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

C. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e., air handlers, fans, pumps, shall be product of a single manufacturer.

D. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

E. Controller shall not add any current or voltage transients to the input ac power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the ac power system.

2.6 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown in the contract documents, and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.

D. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. HVAC and Mechanical Rooms: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING AND COOLING UNITS and Section 23 36 00, AIR TERMNAL UNITS.
2. Valve Tags: Engraved black filled numbers and letters not less than 13 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve Lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 279 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

F. Ceiling Grid Labels:

1. 50 mm (2 inch) long by 13 mm (1/2 inch) wide by 0.025 mm (1 mil) thick UV resistant metalized polyester label with red border color and black custom lettering on white background interior. Peel and stick adhesive backing. Label and adhesive manufactured specifically for use in equipment inventory tagging.
2. Custom print labels with above ceiling HVAC equipment numbers.

2.7 FIRESTOPPING

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC INSULATION, for firestop pipe and duct insulation.

2.8 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

B. Supports for Roof Mounted Items:

1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory-installed 50 by 100 mm (2 by 4 inches) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 279 mm (11

inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.

2. Pipe/Duct Pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-58. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.

D. Attachment to Concrete Building Construction:

1. Concrete Insert: MSS SP-58, Type 18.
2. Self-Drilling Expansion Shields and Machine Bolt Expansion Anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
3. Power-Driven Fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

E. Attachment to Steel Building Construction:

1. Welded Attachment: MSS SP-58, Type 22.
2. Beam Clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp shall be used for individual copper tubing up to 22 mm (7/8 inch) outside diameter.

F. Attachment to Existing Structure: Support from existing floor/roof frame.

G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

H. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 by 41 mm (1-5/8 by 1-5/8 inches), 2.7 mm (12 gauge), designed to accept special spring held, hardened steel nuts. Trapeze hangers are prohibited for use for steam supply and condensate piping.

1. Allowable Hanger Load: Manufacturers rating less 91 kg (200 pounds).
2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

I. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems Except High and Medium Pressure Steam (MSS SP-58):
   a. Standard Clevis Hanger: Type 1; provide locknut.
   b. Riser Clamps: Type 8.
   c. Wall Brackets: Types 31, 32 or 33.
   d. Saddle Support: Type 36, 37 or 38.
   e. Turnbuckle: Types 13 or 15. Preinsulate.
   f. U-bolt Clamp: Type 24.
   g. Copper Tube:
      1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
      2) For vertical runs use epoxy painted or plastic-coated riser clamps.
      3) For Supporting Tube to Strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
      4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

J. Seismic Restraint and Bracing of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127. Refer to Seismic Design Requirements VA Handbook 18-8.

2.9 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For Sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
2. For Blocked Out Floor Openings: Provide 38 mm (1-1/2 inch) angle set in silicone adhesive around opening.

3. For Drilled Penetrations: Provide 38 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations through beams or ribs are prohibited but may be installed in concrete beam flanges. Any deviation from these requirements shall receive prior approval of COR.

D. Sheet Metal, Plastic, or Moisture-Resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast-Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an Alternate Black Iron Pipe with Asphalt Coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.10 DUCT PENETRATIONS

A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 457 mm (18 inches) high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.

B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

2.11 SPECIAL TOOLS AND LUBRICANTS

A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.

E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.12 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch pipe), 0.89 mm (0.035 inch) for larger pipe.

C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.13 ASBESTOS

Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 GENERAL

If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to, all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown in the contract documents.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by COR where working area space is limited.
2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
3. Do not penetrate membrane waterproofing.

F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but shall be provided.

G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final determination on what is accessible and what is not. Comply with NFPA 70.

H. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Concrete and Grout: Use concrete and non-shrink grout 20 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

J. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

K. Work in Existing Building:

1. Perform as specified in paragraphs OPERATIONS AND STORAGE AREAS, paragraph ALTERATIONS, and paragraph RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.

L. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

M. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited

to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

3.3 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a structural engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.

B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 13 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, inline pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:

1. Up to 152 mm (6 inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:

1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

G. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and

wet down demolished materials to eliminate dust. Debris accumulated in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VAMC, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

H. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with contract documents where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the contract documents of the other disciplines in the project for additional facilities to be demolished or handled.

I. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these contract documents. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

J. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

3.4 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.

2. The following material and equipment shall not be painted:
    a. Motors, controllers, control switches, and safety switches.
    b. Control and interlock devices.
    c. Regulators.
    d. Pressure reducing valves.
    e. Control valves and thermostatic elements.
    f. Lubrication devices and grease fittings.
    g. Copper, brass, aluminum, stainless-steel and bronze surfaces.
    h. Valve stems and rotating shafts.
    i. Pressure gauges and thermometers.
    j. Glass.
    k. Nameplates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, fans, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump and fan manufacturer.
5. Paint shall withstand the following temperatures without peeling or discoloration:
    a. Condensate and Feedwater: 38 degrees C (100 degrees F) on insulation jacket surface and 121 degrees C (250 degrees F) on metal pipe surface.
6. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
7. Lead based paints are prohibited.

3.5 IDENTIFICATION SIGNS

A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

D. Attach ceiling grid label on ceiling grid location directly underneath above ceiling air terminal, control system component, valve, filter unit, fan etc.

3.6 MOTOR AND DRIVES

A. Use synchronous belt drives only on equipment controlled by soft starters or variable frequency drive motor controllers without a bypass contactor. Use V-belt drives on all other applications.

B. Alignment of V-Belt Drives: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.

C. Alignment of Synchronous Belt Drives: Set driving and driven shafts parallel and align so that the corresponding pulley flanges are in the same plane.

D. Alignment of Direct-Connect Drives: Securely mount motor in accurate alignment so that shafts are per coupling manufacturer's tolerances when both motor and driven machine are operating at normal temperatures.

3.7 STARTUP, TEMPORARY OPERATION AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and Contractor testing of selected equipment. Coordinate the startup and Contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

D. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.8 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS paragraph TESTS, and in individual Division 23 sections and submit the test reports and records to the COR.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Government.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.

D. No adjustments shall be made during the acceptance inspection. All adjustments shall have been made by this point.

E. Perform tests as required for commissioning provisions in accordance with Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

3.9 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

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SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation and connection of motors for HVAC equipment.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 APPLICABLE PUBLICATIONS

*Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Bearing Manufacturers Association (ABMA):

9 .....Load Ratings and Fatigue Life for Ball Bearings

11 .....Load Ratings and Fatigue Life for Roller Bearings

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

90.1 .....Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

D. Institute of Electrical and Electronics Engineers (IEEE):

112 .....Standard Test Procedure for Polyphase Induction Motors and Generators

841 .....IEEE Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors--Up to and Including 370 kW (500 hp)

E. National Electrical Manufacturers Association (NEMA):

MG 1.....Motors and Generators

MG 2.....Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

250 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA):

.....National Electrical Code (NEC)

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT”, with applicable paragraph identification.

C. Submit motor submittals with driven equipment.

D. Shop Drawings:

1. Provide documentation to demonstrate compliance with contract documents.
2. Motor nameplate information shall be submitted including electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

E. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

G. Certification: Two weeks prior to final inspection, unless otherwise noted, certification shall be submitted to the COR stating that the motors have been properly applied, installed, adjusted, lubricated, and tested.

H. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 MOTORS

A. For alternating current, fractional and integral horsepower motors, NEMA MG 1 and NEMA MG 2 shall apply.

B. For severe duty TEFC motors, IEEE 841 shall apply.

C. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, MOTOR CONTROLLERS; and Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors. Unless otherwise specified for a particular application, use electric motors with the following requirements.

D. Single-phase Motors:

1. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.

a. In order to meet ASHRAE 90.1 requirements, motors for small packaged HVAC equipment may be Electrically Commutated motor (EC type). Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic communication. The motor shall be speed controllable down to 20 percent of full speed and 85 percent efficient at all speeds.

E. Voltage ratings shall be as follows:
   1. Single phase:
      a. Motors connected to 120-volt systems: 115 volts.
      b. Motors connected to 208-volt systems: 200 volts.
      c. Motors connected to 240-volt or 480-volt systems: 230/460 volts, dual connection.
   2. Three phase:
      a. Motors connected to 208-volt systems: 200 volts.
      b. Motors, less than 74.6 kW (100 hp), connected to 240-volt or 480-volt systems: 208-230/460 volts, dual connection.
      c. Motors, 74.6 kW (100 hp) or greater, connected to 240-volt systems: 230 volts.
      d. Motors, 74.6 kW (100 hp) or greater, connected to 480-volt systems: 460 volts.
      e. Motors connected to high voltage systems (Over 600V): Shall conform to NEMA MG 1 for connection to the nominal system voltage shown in the contract documents.
F. Number of phases shall be as follows:
   1. Motors, less than 373 W (1/2 hp): Single phase.
   2. Motors, 373 W (1/2 hp) and greater: 3 phase.
   3. Exceptions:
      a. Hermetically sealed motors.
      b. Motors for equipment assemblies, less than 746 W (1 hp), shall be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.
G. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.
H. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting, acceleration, and running torque without exceeding nameplate ratings or considering service factor.
I. Motor Enclosures:
   1. Shall be the NEMA types as specified and/or shown in the contract documents.
   2. Where the types of motor enclosures are not shown in the contract documents, they shall be the NEMA types per NEMA 250, which are most suitable for the environmental

conditions where the motors are being installed. Enclosure requirements for certain conditions are as follows:

a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.
b. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.
c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.

3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

J. Electrical Design Requirements:

1. Motors shall be continuous duty.
2. The insulation system shall be rated minimum of Class B, 130 degrees C (266 degrees F).
3. The maximum temperature rise by resistance at rated power shall not exceed Class B limits, 80 degrees C (176 degrees F).
4. The speed/torque and speed/current characteristics shall comply with NEMA Design A or B, as specified.
5. Motors shall be suitable for full voltage starting, unless otherwise noted. Coordinate motor features with applicable motor controllers.
6. Motors for variable frequency drive applications shall adhere to NEMA MG 1, Part 30, Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General-Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both, or NEMA MG 1, Part 31, Definite-Purpose Inverter-Fed Polyphase Motors.

K. Mechanical Design Requirements:

1. Bearings shall be rated in accordance with ABMA 9 or ABMA 11 for a minimum fatigue life of 26,280 hours for belt-driven loads and 100,000 hours for direct-drive loads based on L10 (Basic Rating Life) at full load direct coupled, except vertical high thrust motors which require a 40,000 hours rating. A minimum fatigue life of 40,000 hours is required for VFD drives.
2. Vertical motors shall be capable of withstanding a momentary up thrust of at least 30 percent of normal down thrust.

3. Grease lubricated bearings shall be designed for electric motor use. Grease shall be capable of the temperatures associated with electric motors and shall be compatible with Polyurea based greases.
4. Grease fittings, if provided, shall be Alemite type or equivalent.
5. Oil lubricated bearings, when specified, shall have an externally visible sight glass to view oil level.
6. Vibration shall not exceed 3.8 mm (0.15 inch) per second, unfiltered peak.
7. Noise level shall meet the requirements of the application.
8. Motors on 180 frames and greater shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
9. All external fasteners shall be corrosion resistant.
10. Condensation heaters, when specified, shall keep motor windings at least 5 degrees C (9 degrees F) above ambient temperature.
11. Winding thermostats, when specified shall be normally closed, connected in series.
12. Grounding provisions shall be in the main terminal box.

L. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional cost or time to the Government.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.

5. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA MG 1, Part 31, Definite-Purpose Inverter-Fed Polyphase Motors. Provide motor shaft grounding apparatus that shall protect bearings from damage from stray currents.

M. Additional requirements for specific motors, as indicated in the other sections listed in Article, RELATED SECTIONS shall also apply.

N. NEMA Premium Efficiency Electric Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 W (1 hp) or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of 746 W (1 hp) or more with open, drip-proof, or TEFC enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM PREMIUM EFFICIENCIES OPEN DRIP-PROOF				MINIMUM PREMIUM EFFICIENCIES TOTALLY ENCLOSED FAN-COOLED (TEFC)			
RATING KW (HP)	**1200 RPM**	**1800 RPM**	**3600 RPM**	**RATING KW (HP)**	**1200 RPM**	**1800 RPM**	**3600 RPM**
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

O. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM, and 3600 RPM. Power factor correction capacitors shall be provided unless the motor meets the 0.90 requirement without it or if the motor is controlled by a variable frequency drive. The power factor correction capacitors shall be able to withstand high voltage transients and power line variations without breakdown.

P. Energy Efficiency of Small Motors (Motor Efficiencies): All motors under 746 W (1 hp) shall meet the requirements of the DOE Small Motor Regulation.

POLYPHASE OPEN MOTORS AVERAGE FULL LOAD EFFICIENCY				CAPACITOR-START CAPACITOR-RUN AND CAPACITOR-START INDUCTION RUN OPEN MOTORS AVERAGE FULL LOAD EFFICIENCY			
RATING KW (HP)	**6 POLES**	**4 POLES**	**2 POLES**	**RATING KW (HP)**	**6 POLES**	**4 POLES**	**2 POLES**
0.18 (0.25)	**67.5**	**69.5**	**65.6**	**0.18 (0.25)**	**62.2**	**68.5**	**66.6**
0.25 (0.33)	**71.4**	**73.4**	**69.5**	**0.25 (0.33)**	**66.6**	**72.4**	**70.5**
0.37 (0.5)	**75.3**	**78.2**	**73.4**	**0.37 (0.5)**	**76.2**	**76.2**	**72.4**
0.55 (0.75)	**81.7**	**81.1**	**76.8**	**0.55 (0.75)**	**80.2**	**81.8**	**76.2**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown in the contract documents and/or as required by other sections of these specifications.

B. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 FIELD TESTS

A. All tests shall be witnessed by the CxA or by the COR.

B. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before startup. All shall test free from grounds.

C. Perform Load test in accordance with IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

D. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

E. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified

requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification shall be tested as part of a greater system.

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SECTION 23 05 41
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the application of noise control measures, seismic restraints for equipment, tolerance and vibration isolation for HVAC work including pumps, fans, compressors, motors.

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Section 23 31 00, HVAC DUCTS and CASINGS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Civil Engineers (ASCE):
ASCE 7- ..... Minimum Design Loads for Buildings and Other Structures

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
Handbook..... ASHRAE Handbook – HVAC Applications
Handbook..... ASHRAE Handbook - Fundamentals, Chapter 8, Sound and Vibration

D. American Society for Testing and Materials (ASTM):
A123/A123M..... Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A307 ..... Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

B117 ..... Standard Practice for Operating Salt Spray (Fog) Apparatus

D2240 ..... Standard Test Method for Rubber Property - Durometer Hardness

E. International Code Council (ICC):

IBC ..... International Building Code

F. Manufacturers Standardization Society (MSS):

SP-58 ..... Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

G. Occupational Safety and Health Administration (OSHA):

29 CFR 1910.95 ..... Occupational Noise Exposure

H. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):

001 ..... Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd Edition

I. Department of Veterans Affairs (VA):

H-18-8 ..... Seismic Design Requirements

PG-18-10 ..... HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 41 NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Vibration isolators:
   a. Floor mountings
   b. Hangers
   c. Snubbers
   d. Thrust restraints

Bases.3. Seismic restraint provisions and bolting.

2. Acoustical enclosures.

D. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

E. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force requirements as shown in the contract documents.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

B. Noise Criteria:

1. Perform an acoustic analysis to demonstrate that the specified room noise levels are achieved in all octave bands for all air-handling units, heating and ventilating units, fans, chillers, boilers, generators, and outdoor noise producing equipment, such as cooling towers and chillers. Refer to VA HVAC Design Manual Chapter 6 Room Data Sheets for the required Noise Criteria (NC) levels. If the necessary room type is not listed in Chapter 6 of VA HVAC Design Manual then consult the ASHRAE Handbook - HVAC Applications. The analysis shall consider both air duct borne noise and noise transmission through walls, floors and roofs and shall be completed for all duct systems and all HVAC equipment.

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA 29 CFR 1910.95 requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Handbook - Fundamentals, Chapter 8, Sound and Vibration.

3. An allowance, not to exceed 5 db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound

absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.

4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

C. Seismic Restraint Requirements:

1. Equipment:
   a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of50 percent of the weight of the equipment furnished.
   b. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 50 percent of the weight of the equipment furnished.
2. Piping: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
3. Ductwork: Refer to Section 23 31 00, HVAC DUCTS AND CASINGS.

C. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal, and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer. Refer to ASHRAE Handbook - HVAC Applications Chapter 49, Noise and Vibration Control, Table 47 for selection guide for Vibration Isolation.

B. Elastomeric isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.

C. Exposure to Weather: Isolator housings to be either hot dipped galvanized or powder coated to ASTM B117 salt spray testing standards. Springs to be powder coated or electro galvanized. All hardware to be electro galvanized. In addition, provide limit stops to resist wind velocity. Velocity pressure established by wind shall be calculated in accordance with Section 1609 of the International Building Code. A minimum wind velocity of 75 mph shall be employed.

D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

E. Color code isolators by type and size for easy identification of capacity.

2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENT

A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.

B. Provide floor mounted equipment with Type SS vibration Isolators. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment. Size and material required for the base shall be as recommended by the isolator manufacturer.

C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment.

2.3 VIBRATION ISOLATORS

A. Floor Mountings:

1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
3. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be natural rubber or neoprene waffle, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
   1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.

C. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.4 BASES

Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Vibration Isolation:
   1. No metal-to-metal contact will be permitted between fixed and floating parts.
   2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports with a deflection equal to that used on the corresponding equipment.
   3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for

adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.

4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (l00 degrees F).
5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

C. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.

B. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

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SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
2. Design Review Report.
3. Systems Inspection Report.
4. 4. Duct Air Leakage Test Report.
5. 5Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
7. Vibration and sound measurements.
8. Recording and reporting results.

C. Definitions:

1. Basic TAB used in this Section: Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications".
2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. TABB: Testing Adjusting and Balancing Bureau.
6. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
7. Hydronic Systems: Includes chilled water systems.
8. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
9. Flow Rate Tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

G. Section 23 07 11, HVAC INSULATION.

H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

J. Section 23 31 00, HVAC DUCTS AND CASINGS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The following publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

.....ASHRAE Handbook – HVAC Applications, Chapter 39, Testing, Adjusting, and Balancing and Chapter 49, Noise and Vibration Control

C. Associated Air Balance Council (AABC):

.....National Standards for Total System Balance, 7th Edition

D. National Environmental Balancing Bureau (NEBB):

.....Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems, 9th Edition

.....Procedural Standard for the Measurement of Sound and Vibration, 2nd Edition

S110 .....Whole Building Technical Commissioning of New Construction, 2nd Edition

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

.....HVAC Systems Testing, Adjusting and Balancing, 3rd Edition

.....TAB Procedural Guide 1st Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC", with applicable paragraph identification.

C. Submit names and qualifications of TAB agency and TAB Specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

D. For use by the COR staff, submit one complete set of applicable AABC, NEBB or TABB publications that will be the basis of TAB work.

E. Submit the following for review and approval:

1. Design Review Report within 60 days for design-build projects after the system layout on air and water side is completed by the Contractor.
2. Systems inspection report on equipment and installation for conformance with design.
3. Duct Air Leakage Test Report.
4. Systems Readiness Report.
5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
7. Include in each report the critical path for each balanced branch (air and hydronic). Every branch shall have at least one terminal device damper 100 percent open.

F. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area with noted critical paths.

1.5 QUALITY ASSURANCE

A. Refer to paragraphs QUALITY ASSURANCE and SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC, NEBB, or TABB to perform TAB service for HVAC, and water balancing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC, TABB or NEBB within the five (5) years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB Specialist shall be either a member of AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five (5) years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and shall be performed by an approved successor.
4. TAB Specialist shall be identified by the General Contractor within sixty (60) days after the Notice to Proceed. The TAB Specialist will be coordinating, scheduling, and reporting all TAB work and related activities and will provide necessary information as required by the COR. The responsibilities shall specifically include:
    a. Directly supervising all TAB work.
    b. Sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.

c. Following all TAB work through its satisfactory completion.

d. Providing final markings of settings of all HVAC adjustment devices.

e. Permanently mark location of duct test ports.

f. Documenting critical paths from the fan or pump. These critical paths are ones in which are 100 percent open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.

5. All TAB technicians performing actual TAB work shall be experienced and shall have done satisfactory work on a minimum of three (3) projects comparable in size and complexity to this project. Qualifications shall be certified by the TAB agency in writing. The lead technician shall be certified by AABC, TABB or NEBB.

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards, TABB/SMACNA International Standards, or by NEBB Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose. All equipment shall remain in calibration, or be re-calibrated if certification expires, during the TAB procedures.

D. TAB Criteria:

1. One or more of the applicable AABC, NEBB, TABB or SMACNA publications, supplemented by Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications" and requirements stated herein shall be the basis for planning, procedures, and reports.

2. Flow Rate Tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow Chapter 39, "Testing, Adjusting and Balancing" of ASHRAE Handbook "HVAC Applications" as a guideline. Air Filter resistance during tests, artificially imposed, if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.

a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 5 percent to plus 10 percent.

b. Air Terminal Units (maximum values): Minus 5 percent to plus 10 percent

c. Exhaust Hoods/Cabinets: 0 percent to plus 10 percent.

d. Minimum Outside Air: 0 percent to plus 10 percent.

e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus l0 percent except if the air to air space is 100 CFM or less the tolerance will be minus 5 to plus 5 percent.

f. Chilled Water Coils: Minus 5 percent to plus 5 percent.

3. Systems shall be adjusted for energy efficient operation as described in PART 3.

4.

PART 2 - PRODUCTS

2.1 PLUGS

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

See Section 23 07 11, HVAC INSULATION. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to TAB Criteria in Paragraph QUALITY ASSURANCE.

B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

The TAB Specialist shall review the contract documents and advise the COR of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

A. Inspect equipment and installation for conformance with design.

B. The inspection and report shall be done after air distribution and hydronic equipment is onsite and duct and piping installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

C. Reports: Follow checklist format developed by AABC, NEBB or SMACNA (TABB), supplemented by narrative comments, with emphasis on air-handling units and fans. Check for conformance

with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

A. TAB Agency shall perform the leakage test as outlined in "Duct Leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS and CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

3.4 SYSTEM READINESS REPORT

A. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated in the contract documents. Submit report of findings to COR.

A. BInspect each system to ensure that it is complete including installation and operation of controls. Submit report to COR in standard format and forms prepared and/or approved by the CxA.

B. Verify that all items such as ductwork piping, dampers, valves, ports, terminals, connectors, etc., that are required for TAB are installed. Provide a report to the COR.

3.5 TAB REPORTS

A. The TAB Contractor shall provide raw data immediately in writing to the COR if there is a problem in achieving intended results before submitting a formal report.

B. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated after engineering and construction have been evaluated and re-submitted for approval at no additional cost to the owner.

C. Do not proceed with the remaining systems until intermediate report is approved by the COR.

3.6 TAB PROCEDURES

A. TAB shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC, TABB or NEBB. Balancing shall be done proportionally to all applicable systems.

1. At least 1 trunk damper shall be 100 percent open.
2. At least 1 branch damper shall be 100 percent open per trunk.
3. At least 1 terminal device duct be 100 percent open per branch.
4. At least one hydronic balancing valve shall be 100 percent open per hydronic system.

B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre-construction air and water flow rate.

D. Allow 14 days' time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include , room diffusers/outlets/inlets, and computer room AC units.

1. Adjust fan speeds to provide design air flow.
2. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other HVAC controls function properly.
3. Record final measurements for air handling equipment performance data sheets.
4. Record final damper settings for all manual volume dampers.

F. Water Balance and Equipment Test: Include coils:

1. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils. Include entering and leaving air temperatures (DB/WB for cooling coils) for air-handling units, reheat coils, and computer-room air-conditioning units. Make air and water temperature measurements at the same time.
2. On coils with automatic flow limiting valves (automatic balancing valves) measure and report Delta P across valve and measure Delta P across 100 percent open temperature control valve and using control valve CV calculate and report gpm.
3. Record final valve setting for all balancing valves.

3.7 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for

all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the COR. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the COR.

3.8 SOUND TESTING

A. Perform and record required sound measurements in accordance with paragraph QUALITY ASSURANCE in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
   1. Take readings in Data Center and outdoors near the computer room air conditioner condensing units.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC, TABB or NEBB.

C. Sound reference levels, formulas and coefficients shall be according to ASHRAE Handbook "HVAC Applications", Chapter 49, “Noise and Vibration Control”.

D. Determine compliance with contract documents as follows:
   1. When sound pressure levels are specified, including the NC Criteria in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT:
      a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.
      b. Measure octave band sound pressure levels with specified equipment "off."
      c. Measure octave band sound pressure levels with specified equipment "on."
      d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE:	0	1	2	3	4	5 to 9	10 or More
FACTOR:	10	7	4	3	2	1	0

      e. Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.
      f. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.

2. When sound power levels are specified:
   a. Perform steps 1.a. through 1.d., as specified above.
   b. For Indoor Equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
   c. For Outdoor Equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor. Use 9 meters (30 feet) for sound level location.

E. Where measured sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the COR and the necessary sound tests shall be repeated.

F. Test readings for sound testing could go higher than 15 percent if determination is made by the COR based on the recorded sound data.

3.9 MARKING OF SETTINGS

Following approval of TAB Final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the COR.

3.10 IDENTIFICATION OF TEST PORTS

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

3.11 PHASING

A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of the project all areas shall have been tested and balanced per the contract documents.

B. Existing Areas: Systems that serve areas outside of the project scope shall not be adversely affected. Measure existing parameters where shown to document system capacity.

3.124 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

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SECTION 23 07 11
HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping, ductwork and equipment.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
   3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
   4. Concealed: Ductwork and piping above ceilings and in chases, interstitial space, and pipe spaces.
   5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F);HVAC equipment or piping handling media above 41 degrees C (105 degrees F)
   8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
   9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
   10. Thermal conductance: Heat flow rate through materials.
   11. Flat surface: Watt per square meter (BTU per hour per square foot).
   12. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
   13. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).

14. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
15. HPS: High pressure steam (415 kPa [60 psig] and above).
16. HPR: High pressure steam condensate return.
17. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig].
18. MPR: Medium pressure steam condensate return.
19. LPS: Low pressure steam (103 kPa [15 psig] and below).
20. LPR: Low pressure steam condensate gravity return.
21. HWH: Hot water heating supply.
22. HWHR: Hot water heating return.
23. CPD: Condensate pump discharge.
24. FOS: Fuel oil supply.
25. FOR: Fuel oil return.
26. CW: Cold water.
27. HW: Hot water.
28. CH: Chilled water supply.
29. CHR: Chilled water return.
30. GC: Chilled glycol-water supply.
31. GCR: Chilled glycol-water return.
32. RS: Refrigerant suction.
33. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
C. Section 02 82 13. GLOVEBAG ASBESTOS ABATEMENT.
D. Section 07 84 00, FIRESTOPPING.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Section 23 21 13, HYDRONIC PIPING.

H. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING

I. Section 23 22 23, STEAM CONDENSATE PUMPS

J. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT

K. Section 23 51 00, BREECHINGS, CHIMNEYS, and STACKS

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. *(See 4.2.4.2.)*

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

Not exceeding a 25.4 mm (1 in.) average clearance on all sides

Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials

2. Test methods: ASTM E84, UL 723, or NFPA 255.
3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
   a. Insulation materials: Specify each type used and state surface burning characteristics.
   b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
   c. Insulation accessory materials: Each type used.
   d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
   e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

L-P-535E (2)-.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.

C. Military Specifications (Mil. Spec.):

MIL-A-3316C Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-C-19565C (1) Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

MIL-C-20079H .....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

D. American Society for Testing and Materials (ASTM):

A167-99 .....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

B209 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C41 .....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation

C449 .....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C534... .....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C54 .....Standard Specification for Mineral Fiber pipe Insulation

C552 .....Standard Specification for Cellular Glass Thermal Insulation

C553 .....Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C585 .....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)

C612 .....Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C1126 .....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1136-.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

E84 .....Standard Test Method for Surface Burning Characteristics of Building Materials

E119 ..... Standard Test Method for Fire Tests of Building Construction and Materials

E136 ..... Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)

E. National Fire Protection Association (NFPA):

90A ..... Standard for the Installation of Air Conditioning and Ventilating Systems

96 ..... Standard~~s~~ for Ventilation Control and Fire Protection of Commercial Cooking Operations

101 ..... Life Safety Code

251 ..... Standard methods of Tests of Fire Endurance of Building Construction Materials

255 ..... Standard Method of tests of Surface Burning Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723 ..... UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 09/08

G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):

SP58 ..... Pipe Hangers and Supports Materials, Design, and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m^3 (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.

B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 MINERAL WOOL

Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

2.3 RIGID CELLULAR PHENOLIC FOAM

A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, k = 0.021(0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, k = 0.021 (0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, and all service vapor retarder jacket.

2.4 CELLULAR GLASS CLOSED-CELL

A. Comply with Standard ASTM C177, C518, density 120 kg/m^3 (7.5 pcf) nominal, k = 0.033 (0.29) at 24~~0~~ degrees C (75 degrees F).

B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

2.5 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

ASTM C177, C518, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.6 INSULATION FACINGS AND JACKETS

A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

D. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.

E. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

F. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

2.7 ADHESIVE, MASTIC, CEMENT

A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.

B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.

C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.

D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.

E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.

F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

2.8 MECHANICAL FASTENERS

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

A. Staples: Outward clinching monel or galvanized steel.

B. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

C. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.9 REINFORCEMENT AND FINISHES

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.

C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.10 FIRESTOPPING MATERIAL

Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.11 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Where removal of insulation of piping, ductwork and equipment is required to comply with Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT and Section 02 82 13.13, GLOVEBAG ASBESTOS ABATEMENT, such areas shall be reinsulated to comply with this specification.

D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and

exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

E. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

I. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

J. Firestop Pipe and Duct insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
   a. Pipe risers through floors
   b. Pipe or duct chase walls and floors
   c. Smoke partitions
   d. Fire partitions

K. Provide vapor barrier jackets over insulation as follows:

1. All piping and ductwork exposed to outdoor weather.

L. Provide metal jackets over insulation as follows:

1. All piping and ducts exposed to outdoor weather.
2. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
   a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
   b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
   c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
   d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

B. Rigid Cellular Phenolic Foam:
1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.

8. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a maximum water vapor permeance of 0.00 perms.
9. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
    a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

C. Cellular Glass Insulation:
1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
2. Underground Piping Other than or in lieu of that Specified in Section 23 21 13, HYDRONIC PIPING and Section 33 63 00, STEAM ENERGY DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
    a. 75 mm (3 inches) thick for hot water piping.
    b. As scheduled at the end of this section for chilled water piping.
    c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
    d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
    e. Underground insulation shall be inspected and approved by the Resident Engineer as follows:
        1) Insulation in place before coating.
        2) After coating.
    f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.
3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.
4. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a water vapor permeability of 0.00 perms.

D. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:
   a. Use proper size material. Do not stretch or strain insulation.
   b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC
   c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
   a. Chilled water pumps
   b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
   c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
   d. Piping inside refrigerators and freezers: Provide heat tape under insulation.
7. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Wall Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
38-94 degrees C (100-200 degrees F) (HWH, HWHR)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-16 degrees C (37-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Cellular Glass Closed-Cell	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (37-60 degrees F) (CH, CHR, and RS for DX refrigeration)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
(37-60 degrees F) (RS for DX refrigeration)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

- - - E N D - - -

SECTION 23 08 00
COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

D. Section 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT.

E. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

F. Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1.3 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems of the related subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and of Division 23, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility HVAC systems commissioning will include the systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.7 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. Department of Veterans Affairs (VA):

PG 18-10.....Mission Critical Facilities - DRAFT

PG 18-10.....Life-Safety Protected Facilities - DRAFT

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

HANDBOOK.....HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing, Chapter 44, HVAC Commissioning and Chapter 49, Sound and Vibration Control

HANDBOOK.....HVAC Fundamentals ASHRAE Handbook, Chapter 8, Sound and Vibration

D. Associated Air Balance Council (AABC):

7th Edition.....AABC National Standards for Total System Balance

E. National Environmental Balancing Bureau (NEBB):

9th Edition.....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

3rd Edition.....Procedural Standards for the Measurement of Sound and Vibration

2nd Edition... Standard for Whole Building Technical Commissioning of New Construction

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

006 .....HVAC Duct Construction Standard – Metal and Flexible Duct

3rd Edition... HVAC Systems Testing, Adjusting and Balancing

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. Refer to Sections 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT, Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC requirements. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING

REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional requirements.

3.5 TRAINING OF VA PERSONNEL

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

----- END -----

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Contractor shall provide direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include a complete and working direct-digital control system. Include all engineering, programming, configuration/setup hardware and software, controls and installation materials, installation labor, commissioning and startup, training, final project documentation and warranty.

1. Provide a remote user using a standard HTML 5 web browser to access the control system graphics and change adjustable setpoints with the proper password.
2. All new building controllers shall be native BACnet. All new BACnet workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new BACnet workstations, controllers, devices and components shall be accessible using a HTML5 Web browser interface. Browsers shall not require the use of an extension or add on software in order to access aforementioned workstations, controllers, devices, and components.
   a. If used, gateways shall be BTL listed.
   b. If used, gateways shall provide all object properties and read/write services shown on VA-approved interoperability schedules.
3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and any other items required for a complete and fully functional Controls System.
4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The A/E shall designate what each “mechanical systems” is composed of. The contractor administered by this Section of the technical specifications shall provide

controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.

5. The control system shall accommodate 1 Engineering Control Center(s) and the control system shall accommodate 20 web-based Users simultaneously, and the access to the system should be limited only by operator password.

B. Some products are furnished but not installed by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the installation of the products. These products include but are not limited to the following:

1. Control valves.
2. Flow switches.
3. Flow meters.
4. Sensor wells and sockets in piping.
5. Terminal unit controllers.

C. Some products are installed but not furnished by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the procurement of the products. These products include but are not limited to the following:

1. Factory-furnished accessory thermostats and sensors furnished with unitary equipment.

D. Some products are not provided by, but are nevertheless integrated with the work executed by, the contractor administered by this Section of the technical specifications. These products include but are not limited to the following:

1. Fire alarm systems. If zoned fire alarm is required by the project-specific requirements, this interface shall require multiple relays, which are provided and installed by the fire alarm system contractor, to be monitored.
2. Unitary HVAC equipment (split systems) controls. These include:
   a. Discharge temperature control.
   b. Flowrate control.

c. Setpoint reset.

d. Status alarm.

3. Steam trap monitoring system: Monitoring and alarms shall be connected to the ECC via BACnet.

4. Variable frequency drives. These controls, if not native BACnet, will require a BACnet Gateway.

5. The following systems have limited control (as individually noted below) from the ECC:

a. Constant temperature rooms: temperature out of acceptable range and status alarms.

E. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Control system low voltage and communication wiring	23 09 23	23 09 23	23 09 23	N/A
LAN conduits and raceway	23 09 23	23 09 23	N/A	N/A
Automatic dampers (not furnished with equipment)	23 09 23	23	N/A	N/A
Automatic damper actuators	23 09 23	23 09 23	23 09 23	23 09 23
Manual valves	23	23	N/A	N/A
Automatic valves	23 09 23	23	23 09 23	23 09 23
Pipe insertion devices and taps, flow and pressure stations.	23	23	N/A	N/A
Thermowells	23 09 23	23	N/A	N/A
Current Switches	23 09 23	23 09 23	23 09 23	N/A
Control Relays	23 09 23	23 09 23	23 09 23	N/A
Power distribution system monitoring interfaces	23 09 23	23 09 23	23 09 23	26
All control system nodes, equipment, housings, enclosures and panels.	23 09 23	23 09 23	23 09 23	26
Smoke detectors	28 31 00	28 31 00	28 31 00	28 31 00
Fire/Smoke Dampers	23	23	28 31 00	28 31 00
Water treatment system	23	23	23	26
VFDs	23	26	23 09 23	26
Refrigerant monitors	23	23 09 23	23 09 23	26
Computer Room A/C Unit field-mounted controls	23	23	26	26
Control system interface with CRU A/C controls	23 09 23	23 09 23	23 09 23	26

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
CRU A/C unit controls interface with control system	23	23 09 23	23 09 23	26
Fire Alarm shutdown relay interlock wiring	28	28	28	26
Control system monitoring of fire alarm smoke control relay	28	28	23 09 23	28
Fire-fighter's smoke control station (FSCS	28	28	28	28
Fan Coil Unit controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26
Starters, HOA switches	23	23	N/A	26

F. This facility's existing direct-digital control (DDC) system is manufactured by Siemens. . The contractor administered by this Section of the technical specifications shall observe the capabilities, communication network, services, spare capacity of the existing control system and its ECC prior to beginning work.

G. This campus has standardized on an existing standard ASHRAE Standard 135, BACnet/IP Control System supported by a preselected controls service company. This entity is referred to as the "Control System Integrator" in this Section of the technical specifications. The Control system integrator is responsible for ECC system graphics and expansion. It also prescribes control system-specific commissioning/ verification procedures to the contractor administered by this Section of the technical specification. It lastly provides limited assistance to the contractor administered by this Section of the technical specification in its commissioning/verification work.

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.
2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of

the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator's B-AWS through an Ethernet connection provided by either the Control System Integrator or VA.

3. The contractor administered by this Section of the technical specifications shall provide a peer-to-peer networked, stand-alone, distributed control system. This direct digital control (DDC) system at least shall include one portable operator terminal - laptop, one digital display unit, microprocessor-based controllers, instrumentation, end control devices, wiring, piping, software, and related systems. This contractor is responsible for all device mounting and wiring.
4. Responsibility Table:

Item/Task	Section 23 09 23 contactor	Control system integrator	VA
ECC expansion		X	
ECC programming		X	
Devices, controllers, control panels and equipment	X		
Point addressing: all hardware and software points including setpoint, calculated point, data point(analog/ binary), and reset schedule point	X		
Point mapping		X	
Network Programming	X		
ECC Graphics		X	
Controller programming and sequences	X		
Integrity of LAN communications			X
Electrical wiring	X		
Operator system training		X	
LAN connections to devices			X
LAN connections to ECC			X
IP addresses			X
Overall system verification (Cx)		X	
Controller and system verification	X		

H. Unitary standalone systems including Unit Heaters, Cabinet Unit Heaters, Fan Coil Units, Base Board Heaters, thermal comfort ventilation fans, and similar units for control of room environment conditions may be equipped with integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents. Application of standalone unitary controls is limited to at least those systems wherein remote monitoring, alarm and startup are not necessary. Examples of such systems include:

1. Light-switch-operated toilet exhaust
2. Vestibule heater
3. Exterior stair heater

4. Attic heating and ventilation
5. Mechanical or electrical room heating and ventilation.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
B. Section 23 21 13, Hydronic Piping.
C. Section 23 31 00, HVAC Ducts and Casings.
D. Section 23 81 00, Decentralized Unitary HVAC Equipment.
E. Section 23 81 23, Computer-Room Air-Conditioners.
F. Section 26 05 11, Requirements for Electrical Installations.
G. Section 26 05 21, Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below).
H. Section 26 05 26, Grounding and Bonding for Electrical Systems.
I. Section 26 05 33, Raceway and Boxes for Electrical Systems.
J. Section 28 31 00, Fire Detection and Alarm.

1.3 DEFINITION

A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.
B. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.
C. BACnet: A Data Communication Protocol for Building Automation and Control Networks -as defined by ANSI/ASHRAE Standard 135. This communications protocol allows diverse building automation devices to communicate data and services over a network.
D. BACnet/IP: Annex J of Standard 135. It defines and allows for using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP sub-networks that share the same BACnet network number.
E. BACnet Internetwork: Two or more BACnet networks connected with routers. The two networks may use different LAN technologies.
F. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.
G. BACnet Segment: One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.
H. BACnet Broadcast Management Device (BBMD): A communications device which broadcasts BACnet messages to all BACnet/IP devices and other BBMDs connected to the same BACnet/IP network.

I. BACnet Interoperability Building Blocks (BIBBs): BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork.

J. BACnet Testing Laboratories (BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

K. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).

L. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.

M. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.

N. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.

O. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls

P. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).

Q. Device: a control system component that contains a BACnet Device Object and uses BACnet to communicate with other devices.

R. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

S. Device Profile: A specific group of services describing BACnet capabilities of a device, as defined in ASHRAE Standard 135, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing which service and BIBBs are supported by the device.

T. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.

U. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.

V. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.

W. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

X. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.

Y. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.

Z. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.

AA. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.

BB. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

CC. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.

DD. Gateway: Communication hardware connecting two or more different protocols. It translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

EE. GIF: Abbreviation of Graphic interchange format.

FF. Graphic Program (GP): Program used to produce images of air handler systems, fans, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.

GG. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.

HH. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc., whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

II. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to “sockets” without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

JJ. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.

KK. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

LL. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.

MM. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

NN. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

OO. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

PP. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

QQ. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

RR. Operating system (OS): Software, which controls the execution of computer application programs.

SS. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

TT. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

UU. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.

VV. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.

WW. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.

XX. Repeater: A network component that connects two or more physical segments at the physical layer.

YY. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

ZZ. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.

AAA. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

1.4 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of subcontractor: Either the DDC Contractor or the System Integrator shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The Integration subcontractor shall be responsible for the complete design, installation, integration, and

commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.

2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative could observe the control systems in full operation.
4. The controls subcontractor shall have an in-place facility within 50 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
5. The controls subcontractor shall have minimum of three years of experience in design and installation of building automation systems similar in performance to those specified in this Section.
6. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.

B. Codes and Standards:
1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

1.5 PERFORMANCE

A. The system shall conform to the following:
1. Graphic Display: The system shall display up to four (4) graphics on a single screen with a minimum of twenty (20) dynamic points per graphic. All current data shall be displayed within ten (10) seconds of the request.

2. Graphic Refresh: The system shall update all dynamic points with current data within eight (8) seconds. Data refresh shall be automatic, without operator intervention.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be two(2) seconds. Analog objects shall start to adjust within two (2) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior six (6) seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.
8. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every one (1) second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
9. Reporting Accuracy: Listed below are minimum acceptable reporting end-to-end accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Space temperature	±0.5 degrees C (±1 degrees F)
Ducted air temperature	±0.5 degrees C [±1 degrees F]
Outdoor air temperature	±1.0 degrees C [±2 degrees F]
Dew Point	±1.5 degrees C [±3 degrees F]
Water temperature	±0.5 degrees C [±1 degrees F]
Relative humidity	±2 percent RH
Water flow	±1 percent of reading
Air flow (terminal)	±10 percent of reading
Air pressure (ducts)	±25 Pa [±0.1 inch wg]
Air pressure (space)	±0.3 Pa [±0.001 inch wg]
Water pressure	±2 percent of full scale *Note 1
Electrical Power	±0.5 percent of reading

Note 1: for both absolute and differential pressure

10. Control stability and accuracy: Control sequences shall maintain measured variable at setpoint within the following tolerances:

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 inch wg)	0–1.5 kPa (0–6 inch wg)
Air Pressure	±3 Pa (±0.01 inch wg)	-25 to 25 Pa (-0.1 to 0.1 inch wg)
Airflow	±10 percent of full scale	
Space Temperature	±1.0ºC (±2.0 degrees F)	
Duct Temperature	±1.5ºC (±3 degrees F)	
Humidity	±5 percent RH	MRI, SPS, PHARMACY
Fluid Pressure	±10 kPa (±1.5 psig)	0–1 MPa (1–150 psig)
Fluid Pressure	±250 Pa (±1.0 inch wg)	0–12.5 kPa (0–50 inch wg) differential

11. Extent of direct digital control: control design shall allow for at least the points indicated on the points lists on the drawings.

1.6 WARRANTY

A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.

B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.

C. The on-line support service shall allow the Controls supplier to dial out over telephone lines to or connect via (through password-limited access) VPN through the internet to monitor and control the facility's building automation system. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported. This coverage shall include normal business hours, after business hours, weekend and holidays. If the problem cannot be resolved with on-line support services, the Controls supplier shall dispatch the qualified personnel to the job site to resolve the problem within 24 hours after the problem is reported.

1.7 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including:

1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
3. Control dampers and control valves schedule, including the size and pressure drop.
4. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
5. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.
6. Sequence of operations for each system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
7. Color prints of proposed graphics with a list of points for display.
8. Furnish a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet-compliant device.
9. Schematic wiring diagrams for all control, communication and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.

10. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
11. Riser diagrams of wiring between central control unit (CCU) and all control panels.
12. Plan drawings showing routing of LAN and locations of control panels, controllers, routers, gateways, ECC, and larger controlled devices.
13. Construction details for all installed conduit, cabling, raceway, cabinets, and similar. Construction details of all penetrations and their protection.
14. Quantities of submitted items may be reviewed but it is the responsibility of the contractor administered by this Section of the technical specifications to provide sufficient quantities for a complete and working system.

D. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

E. Validation Test Plan: Along with manufacturer's literature, product certificates, wiring and functional diagrams, and sequence of operations, submit for review and approval a Validation Test Plan which is specific to the work of this project and which references the specific controls component nomenclatures found in the control contractor's wiring and functional diagrams and the specific sequences of controls for this project and which describes how the contractor will implement the controls system validation and demonstration as specified in paragraph 3.2 SYSTEM VALIDATION AND DEMONSTRATION found in this section.

F. Licenses: Provide licenses for all software residing on and used by the Controls Systems, ECC, and portable OWS and transfer these licenses to the Owner prior to completion.

G. As Built Control Drawings:
   1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
   2. Furnish one (1) set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.
   3. Furnish one (1) CD-ROM in CAD DWG and/or .DXF format for the drawings noted in subparagraphs above.

H. Operation and Maintenance (O/M) Manuals):
   1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
   2. Include the following documentation:

a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
c. Three copies of the final version of all software provided including operating systems, programming language, operator workstation software, graphics software and specialized access control devices, and all master level passwords.
d. Complete troubleshooting procedures and guidelines for all systems.
e. Complete operating instructions for all systems.
f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
h. Licenses, guaranty, and other pertaining documents for all equipment and systems.

I. Submit Performance Report to COR prior to final inspection.

1.8 INSTRUCTIONS

A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below. Contractor shall also video tape instruction sessions noted below.
   1. Formal instructions to the VA facilities personnel for a total of 16 hours, given in multiple training sessions (each no longer than four hours in length), conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.
   2. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
   3. Training shall be given by direct employees of THE CONTROLS system subcontractor.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35 degrees C (65 to 90 degrees F) at a relative humidity of 20 to 80 percent non-condensing.

B. The Controllers used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at –40 to 65 degrees C (-40 to 150 degrees F).

C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.

D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

135 ..... BACnet A Data Communication Protocol for Building Automation and Control Networks

147 ..... Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

C. Federal Communication Commission (FCC):

Rules and Regulations Title 47 Chapter 1-2014 Part 15: Radio Frequency Devices

D. Institute of Electrical and Electronic Engineers (IEEE):

802.3 ..... Standard for Ethernet

E. National Fire Protection Association (NFPA):

70 ..... National Electric Code

PART 2 - PRODUCTS

2.1 MATERIALS

Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Spare parts shall be available for at least five years after completion of this contract.

2.2 CONTROLS SYSTEM ARCHITECTURE

A. General
   1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
   2. The ECC, building controllers and principal communications network equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor.
   3. The networks shall, at minimum, comprise, as necessary, the following:
      a. A fixed ECC and a portable operator's terminal.
      b. Network computer processing, data storage and BACnet-compliant communication equipment including Servers and digital data processors.
      c. BACnet-compliant routers, bridges, switches, hubs, modems, gateways, interfaces and similar communication equipment.
      d. Active processing BACnet-compliant building controllers connected to other BACnet-compliant controllers together with their power supplies and associated equipment.
      e. Addressable elements, sensors, transducers and end devices.
      f. Third-party equipment interfaces and gateways as described and required by the Contract Documents.
      g. Other components required for a complete and working Control Systems as specified.
B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, and to meet all requirements of the Contract Documents.
C. Network Architecture
   1. The Controls communication network shall utilize BACnet communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.

2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations.
3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the VA.

D. Third Party Interfaces:

1. The contractor administered by this Section of the technical specifications shall include necessary hardware, equipment, software and programming to allow data communications between the controls systems and building systems supplied by other trades.
2. Other manufacturers and contractors supplying other associated systems and equipment shall provide their necessary hardware, software and startup at their cost and shall cooperate fully with the contractor administered by this Section of the technical specifications in a timely manner and at their cost to ensure complete functional integration.

2.3 NETWORK AND DEVICE NAMING CONVENTION

A. Network Numbers

1. BACnet network numbers shall be based on a "facility code, network" concept. The "facility code" is the VAMC's or VA campus' assigned numeric value assigned to a specific facility or building. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internet work.
2. The network numbers are thus formed as follows: "Net #" = "FFFNN" where:
   a. FFF = Facility code (see below)
   b. NN = 00-99 This allows up to 100 networks per facility or building

B. Device Instances

1. BACnet allows 4194305 unique device instances per BACnet internet work. Using Agency's unique device instances are formed as follows: "Dev #" = "FFFNNDD" where
   a. FFF and N are as above and
   b. DD = 00-99, this allows up to 100 devices per network.
2. Note Special cases, where the network architecture of limiting device numbering to DD causes excessive subnet works. The device number can be expanded to DDD and the network number N can become a single digit. In NO case shall the network number N and the device number D exceed 4 digits.
3. Facility code assignments:

4. 000-400 Building/facility number
5. Note that some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes greater than 400 will be assigned in the range 000-399.

C. Device Names

1. Name the control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The intent of the device naming is to be easily recognized. Names can be up to 254 characters in length, without embedded spaces. Provide the shortest descriptive, but unambiguous, name. For example, in building #123 prefix the number with a “B” followed by the building number, if there is only one chilled water pump "CHWP-1", a valid name would be "B123.CHWP. 1.STARTSTOP". If there are two pumps designated "CHWP-1", one in a basement mechanical room (Room 0001) and one in a penthouse mechanical room (Room PH01), the names could be "B123.R0001.CHWP.1. STARTSTOP" or "B123.RPH01.CHWP.1.STARTSTOP". In the case of unitary controllers, for example a VAV box controller, a name might be "B123.R101.VAV". These names should be used for the value of the "Object_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

2.4 BACnet DEVICES

A. All BACnet Devices – controllers, gateways, routers, actuators, Operator Displays, and sensors shall conform to BACnet Device Profiles and shall be BACnet Testing Laboratories (BTL) -Listed as conforming to those Device Profiles. Protocol Implementation Conformance Statements (PICSs), describing the BACnet capabilities of the Devices shall be published and available for the Devices through links in the BTL website.

1. BACnet Building Controllers, shall conform to the BACnet B-BC Device Profile, and shall be BTL-Listed as conforming to the B-BC Device Profile. The Device’s PICS shall be submitted.
2. BACnet Advanced Application Controllers shall conform to the BACnet B-AAC Device Profile and shall be BTL-Listed as conforming to the B-AAC Device Profile. The Device’s PICS shall be submitted.
3. BACnet Application Specific Controllers shall conform to the BACnet B-ASC Device Profile and shall be BTL-Listed as conforming to the B-ASC Device Profile. The Device’s PICS shall be submitted.

4. BACnet Smart Actuators shall conform to the BACnet B-SA Device Profile and shall be BTL-Listed as conforming to the B-SA Device Profile. The Device's PICS shall be submitted.
5. BACnet Smart Sensors shall conform to the BACnet B-SS Device Profile and shall be BTL-Listed as conforming to the B-SS Device Profile. The Device's PICS shall be submitted.
6. BACnet routers and gateways shall conform to the BACnet B-OTH Device Profile, and shall be BTL-Listed as conforming to the B-OTH Device Profile. The Device's PICS shall be submitted.

2.5 CONTROLLERS

A. General. Provide an adequate number of BTL listed B-BC building controllers, BTL listed B-AAC, BTL listed B-ASC, BTL listed B-SA, and BTL listed B-SS's to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.

1. Communication.
   a. Each B-BC controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications.
   b. Each B-BC controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal. If this port is not available built into the controller, contractor is to install a 4 port unmanaged switch inside the B-BC control cabinet.
2. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. Provide a system security password to prevent unauthorized use of the keypad and display.
3. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
4. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
5. The controller shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown less than 80 percent nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 watt at 1 meter (3 feet).

6. Transformer. Power supply for the ASC must be rated at a minimum of 125 percent of B-ASC power consumption and shall be of the fused or current limiting type.

B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.

1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
2. Each B-ASC will contain sufficient I/O capacity to control the target system.
3. Communication.
   a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
   b. Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown.
4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.
6. Immunity to power and noise. Controllers shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 watts at 1 meter (3 feet).

C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.
2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.

3. All control functions shall execute within the stand-alone control units. All new controllers installed will also include all software and/or hardware required to program, commission, or alter the sequence of operation of said controller(s). Controllers requiring software or hardware that is not commercially available will not be allowed. Installation of software and/or hardware for controller configuration will be the responsibility of the DDC contractor. COR will direct to install said hardware and/or software on either the B-AWS or portable operator terminal. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters without requiring the services of a DDC contractor.
4. All controllers shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.
5. All DDC control loops shall be able to utilize any of the following control modes:
   a. Two position (on-off, slow-fast) control.
   b. Proportional control.
   c. Proportional plus integral (PI) control.
   d. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time-initiated program.
   e. Automatic tuning of control loops.
6. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of three (3)or a maximum of six (6) levels of security for operator access shall be provided.
7. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers.

Editing of the application shall occur at the ECC or via a portable operator's terminal, when it is necessary, to access directly the programmable unit.

a. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.

b. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.

c. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

d. Chilled water Plant Operation: This program shall have the ability to sequence the multiple chillers to minimize energy consumption. The program shall provide sequence of operation as described on the drawings and include the following as a minimum:

    1) Automatic start/stop of chillers and auxiliaries in accordance with the sequence of operation shown on the drawings, while incorporating requirements and restraints, such as starting frequency of the equipment imposed by equipment manufacturers.
    2) Secondary chilled water pumps and controls.
    3) Generate chilled water plant load profiles for different seasons for use in forecasting efficient operating schedule.
    4) Cooling Tower Operation Program: The objective of cooling tower control is to optimize chiller/tower energy use within the equipment restraints and minimum

condenser water temperature limit recommended by the equipment manufacturer. Maintain chilled water plant performance records and print reports at intervals selected by the operator. It shall be possible for the operator to change the set points and the operating schedule.

5) The chilled water plant program shall display the following as a minimum:
   a) Secondary chilled flow rate.
   b) Secondary chilled water supply and return temperature.
   c) Condenser water supply and return temperature.
   d) Outdoor air dry bulb temperature.
   e) Outdoor air wet bulb temperature.
   f) Ton-hours of chilled water per day/month/year.
   g) On-off status for each chiller.
   h) Chilled water flow rate.
   i) Chilled water supply and return temperature.
   j) Operating set points-temperature and pressure.
   k) Kilowatts and power factor.
   l) Current limit set point.
   m) Date and time.
   n) Operating or alarm status.
   o) Operating hours.

2.6 SPECIAL CONTROLLERS

A. Laboratory rooms and the fume hoods in those rooms shall be controlled to allow for a variable flow of conditioned air into the room, general exhaust from the room, and exhaust through the fume hood while maintaining a safe face velocity at the hood sash opening and proper space pressurization.

B. Fume Hood Exhaust Air Controller: The air flow through the open face of the hood, regardless of sash position, shall be controlled at a face velocity between 30 to 36 meter per minute (100 fpm and 120 fpm). A velocity sensor controller located in a sampling tube in the side wall of the hood shall control a damper in the hood discharge to maintain the face velocity.

C. Room Differential Pressure Controller: The differential pressure in laboratory rooms, operating rooms, in the SPS area, Chemo compounding rooms, and isolation rooms shall be maintained by controlling the quantity of air exhausted from or supplied to the room. A sensor-controller shall

measure and control the velocity of air flowing into or out of the room through a sampling tube installed in the wall separating the room from the adjacent space and display the value on its monitor. The sensor-controller shall meet the following as a minimum:

1. Operating range: -0.25 to +0.25 inches of water column
2. Resolution: 5 percent of reading
3. Accuracy: +/- 10 percent of reading +/- 0.005 inches of water column
4. Analog output: 4-20 ma or 0-10 VDC
5. Operating temperature range: 32 degrees F - 120 degrees F

2.7 SENSORS (AIR, WATER, TEMPERATURE AND HUMIDITY)

A. Sensors' measurements shall be read back to the DDC system, and shall be visible by the ECC.

B. Temperature and Humidity Sensors shall be electronic, vibration and corrosion resistant for wall, mounting. Provide all remote sensors as required for the systems.

1. Temperature Sensors: Resistance Temperature Device (RTD) with an integral 4-20 mA or 0-10 VDC transmitter.
   a. Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. Temperature well shall be filled with a thermal compound compatible with installed sensor.
   b. All space sensors shall be equipped with numerical temperature display on sensor cover, and BACnet communication port.. Provide a tooled-access cover.
   c. Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
2. Humidity Sensors: Bulk polymer sensing element type.
   a. Room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
   b. Continuous Output Signal: 4-20 mA or 0-10 VDC.

C. Static Pressure Sensors: Non-directional, temperature compensated.

1. 4-20 mA or 0-10 VDC output signal.
2. 0 to 5 inches wg for duct static pressure range.
3. 0 to 0.25 inch wg for Building static pressure range.

D. Steam Flow Sensor/Transmitter:

1. Sensor: Vortex shedder incorporating wing type sensor and amplification technology for high signal-to-noise ratio, carbon steel body with 316 stainless steel working parts, 24 VDC power, NEMA 4 enclosure.
    a. Ambient conditions, -40 degrees C to 80 degrees C (-40 degrees F to 175 degrees F).
    b. Process conditions, 900 kPa (125 psig) saturated steam.
    c. Turn down ratio, 20 to 1.
    d. Output signal, 4-20 ma or 0-10 VDC DC.
    e. Processor/Transmitter, NEMA 4 enclosure with keypad program selector and six digit LCD output display of instantaneous flow rate or totalized flow, solid state switch closure signal shall be provided to the nearest DDC panel for totalization.
        1) Ambient conditions, -20 degrees C to 50 degrees C (0 degrees F to 120 degrees F), 0 to 95 percent non-condensing RH.
        2) Power supply, 120 VAC, 60 hertz or 24 VDC.
        3) Internal battery, provided for 24-month retention of RAM contents when all other power sources are removed.
    f. Sensor on all steam lines shall be protected by pigtail siphons installed between the sensor and the line, and shall have an isolation valve installed between the sensor and pressure source.

2.8 CONTROL CABLES

A. General:
1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 27 05 26 and 26 05 26.
2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.

5. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.
7. Contractor shall confirm color coding with COR at submittal phase.

B. Analogue control cabling shall be not less than No. 18 AWG solid or stranded, with thermoplastic insulated conductors as specified in Section 26 05 21.

C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 27 15 00.
   1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.

D. All MS/TP communications cables for devices utilizing the EIA-485 standard must be listed for use on EIA-485 networks by the manufacturer of the cable. This requirement overrides any cable recommendation by the controller manufacturer. The use of EIA-485 communication cables shall not affect the warranty from the installing DDC contractor. Cables shall have the following characteristic:
   1. Nominal Impedance: 100-130 Ohms
   2. Twisted/shielded construction of 1, 1.5, or 2 pairs depending on controller requirements.
   3. Be plenum rated
   4. Cables designated for use by the cable manufacturer for use in PA or Speaker systems shall not be allowed, regardless of recommendations by the controller manufacturer.

E. Optical digital communication fiber, if used, shall be Multimode or Single mode fiber, 62.5/125 micron for multimode or 10/125 micron for single mode micron with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber and shall be as specified in Section 27 15 00. Fiber-optic cable shall be

suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

2.9 AIR FLOW CONTROL

Airflow and static pressure shall be controlled via digital controllers with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be analog or pulse width modulating output signals. The controllers shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

2.10 SAFETY

Provide hard-wired interlocked connections for such all safety devices, such as freeze stats, smoke detectors, smoke dampers, and refrigerant leak detection devices. All safety devises shall be provided with additional dry contacts and shall be connected to the DDC system for monitoring and sequencing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COR for resolution before proceeding for installation.
   2. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
   3. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
   4. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
   5. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
   6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
   7. Install equipment level and plumb.
B. Electrical Wiring Installation:

1. All wiring and cabling shall be installed in conduits. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Conduits carrying control wiring and cabling shall be dedicated to the control wiring and cabling: these conduits shall not carry power wiring. Provide plastic end sleeves at all conduit terminations to protect wiring from burrs.
2. Install analog signal and communication cables in conduit and in accordance with Specification Division 27 – COMMUNICATIONS. Install digital communication cables in conduit and in accordance with Specification Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.
    a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
    b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
    c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
    d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.

7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
8. Grounding: ground electrical systems per manufacturer's written requirements for proper and safe operation.

C. Install Sensors and Controls:

1. Temperature Sensors:
   a. Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
   b. Calibrate sensors to accuracy specified, if not factory calibrated.
   c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
   d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor unless otherwise noted on the plans or drawings.
   e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors form contact with metal casings and coils using insulated standoffs.
   f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
   g. All pipe mounted temperature sensors shall be installed in wells.
   h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
   i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.
2. Pressure Sensors:
   a. Install duct static pressure sensor tips facing directly downstream of airflow.
   b. Install high-pressure side of the differential switch between the pump discharge and the check valve.

c. Install snubbers and isolation valves on steam pressure sensing devices.

3. Actuators:
   a. Mount and link damper and valve actuators according to manufacturer's written instructions.
   b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
   c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
4. Flow Switches:
   a. Install flow switch according to manufacturer's written instructions.
   b. Mount flow switch a minimum of 10 pipe diameters up stream and 10 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
   c. Assure correct flow direction and alignment.
   d. Mount in horizontal piping-flow switch on top of the pipe.

D. Installation of digital controllers and programming:
1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be human readable, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of

the controls and instrumentation system. When formal commissioning is included in the project the system validation/test shall be part of the commissioning and shall be witnessed by the CxA.

B. Validation

1. Prepare and submit for approval a validation test plan including test procedures for the performance verification tests. Test Plan shall be submitted for review with the control system submittal as indicated in paragraph 1.7 Submittals. Test Plan address all specified functions of the ECC and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a test check list to be used by the Installer's agent to check and initial that each test has been successfully completed. Deliver test plan documentation for the performance verification tests to the owner's representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
2. After approval of the validation test plan, installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to ensure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.

C. Demonstration

1. System operation and calibration to be demonstrated by the installer in the presence of the Architect, CxA or COR on random samples of equipment as dictated by the COR. Should random sampling indicate improper work, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.
2. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
3. The following witnessed demonstrations of field control equipment shall be included:
   a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
   b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
   c. Demonstrate the software ability to edit the control program off-line.

d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) minute(s). Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hourss to instruct each VA personnel responsible in the operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

----- END -----

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Water piping to connect HVAC equipment, including the following:

1. Chilled water and heating hot water and drain piping.
2. Extension of domestic water make-up piping for HVAC systems.
3. Glycol-water piping.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

H. Section 23 07 11, HVACINSULATION.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B1.20.1 .....Pipe Threads, General Purpose, Inch

B16.5 ..... Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9 ..... Factory Made Wrought Buttwelding Fittings

B16.11 ..... Forged Fittings, Socket-Welding and Threaded

B16.18 ..... Cast Copper Alloy Solder Joint Pressure Fittings

B16.22 ..... Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24 ..... Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B16.39 ..... Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300

B16.42 ..... Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300

B31.9 ..... Building Services Piping

B40.100 ..... Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code (BPVC):

BPVC Section VIII ..... Rules for Construction of Pressure Vessels, Division 1

C. American Society for Testing and Materials (ASTM):

A47/A47M ..... Standard Specification for Ferritic Malleable Iron Castings

A183 ..... Standard Specification for Carbon Steel Track Bolts and Nuts

A193/193M ..... Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A194/194M ..... Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

B62 ..... Standard Specification for Composition Bronze or Ounce Metal Castings

B88 ..... Standard Specification for Seamless Copper Water Tube

F439 ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441/F441M ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

D. American Welding Society (AWS):

B2.1/B2.1M ..... Specification for Welding Procedure and Performance Qualification

E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67 .....Butterfly Valves

SP-80 .....Bronze Gate, Globe, Angle, and Check Valves

SP-110 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

F. National Fire Protection Association (NFPA):

70-2020 .....National Electrical Code (NEC)

G. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards.....10th Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pipe and equipment supports. Pipe and tubing, with specification, class or type, and schedule.
2. Pipe fittings, including miscellaneous adapters and special fittings.
3. Couplings and fittings.
4. Valves of all types.
5. Strainers.
6. Flexible connectors for water service.
7. Expansion joints.
8. Expansion compensators.
9. All specified hydronic system components.
10. Water flow measuring devices.
11. Gauges.
12. Thermometers and test wells.
13. Seismic bracing details for piping.

D. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:

1. Heat exchangers (Water to Water).
2. Air separators.
3. Expansion tanks.

E. Submit the welder's qualifications in the form of a current (less than 1-year old) and formal certificate.

F. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. As-Built Piping Diagrams: Provide drawings as follows for chilled water, and heating hot water system and other piping systems and equipment.

H. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than 1-year old.

C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

E. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.7 SPARE PARTS

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Chilled Water and Vent Piping:
   1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
   2. Copper Water Tube Option: ASTM B88, Type K or L, hard drawn.
B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.
C. Cooling Coil Condensate Drain Piping:
   1. From Air Handling Units: Copper water tube, ASTM B88, Type M. Use of PVC piping is prohibited in exterior applications.
   2. From Fan Coil or Other Terminal Units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.
D. Pipe supports, including insulation shields, for aboveground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded joints.
   1. Butt Welding: ASME B16.9 with same wall thickness as connecting piping.
   2. Forged Steel, Socket Welding or Threaded: ASME B16.11.
   3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast-iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is prohibited.
   4. Unions: ASME B16.39.
   5. Water Hose Connection Adapter: Brass, pipe thread to 19 mm (3/4 inch) garden hose thread, with hose cap nut.

B. 63 mm (2-1/2 inches) and Larger: Welded or flanged joints.
   1. Butt Welding Fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
   2. Welding Flanges and Bolting: ASME B16.5:
      a. Water Service: Weld neck or slip-on, plain face, with 3.2 mm (1/8 inch) thick full-face neoprene gasket suitable for 104 degrees C (220 degrees F).
         1) Contractor's Option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
         2) Flange Bolting: Carbon steel machine bolts or studs and nuts, ASTM A193/193M, Class 2, Grade B7 for bolts and ASTM A194/194M for nuts.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets shall be used for branch connections up to 1 pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 shall be used for drain, vent, and gauge connections.

2.4 FITTINGS FOR COPPER TUBING

A. Joints:

   Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

C. 63 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating: 99 degrees C (210 degrees F).

2.6 SCREWED JOINTS

A. Pipe Thread: ASME B1.20.1.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

A. Asbestos packing is prohibited.

B. All valves of the same type shall be products of a single manufacturer.

C. Shut-Off Valves:

1. Ball Valves (Pipe Sizes 50 mm (2 inch) and Smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 400 psigworking pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
2. Butterfly Valves (Pipe Sizes 63 mm (2-1/2 inch) and Larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 1200 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
   a. Body: Cast-iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
   b. Trim: Bronze, aluminum bronze, or 300 series stainless-steel disc, bronze bearings, 316 stainless-steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable if the stem is completely isolated from the product.
3. Gate Valves:
   a. 50 mm (2 inches) and Smaller: MSS SP-80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
   b. 63 mm (2-1/2 inches) and Larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 860 kPa (125 psig) wedge disc.
4. Field Interchangeable Actuators: Valves for balancing service shall have adjustable memory stop to limit open position.
   a. Valves 152 mm (6 inches) and Smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
   b. Valves 203 mm (8 inches) and Larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.

D. Globe and Angle Valves:
   1. Globe Valves:
      a. 50 mm (2 inches) and Smaller: MSS SP-80, bronze, 1034 kPa (150 psig) Globe valves shall be union bonnet with metal plug type disc.
      b. 63 mm (2-1/2 inches) and Larger: 860 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-85 for globe valves.

E. Check Valves:
   1. Swing Check Valves:
      a. 50 mm (2 inches) and Smaller: MSS SP-80, bronze, 1034 kPa (150 psig), 45-degree swing disc.
      b. 63 mm (2-1/2 inches) and Larger: 860 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-71 for check valves.
   2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
      a. Body: MSS SP-125 cast-iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
      b. Seat, Disc and Spring: 18-8 stainless-steel, or bronze, ASTM B62. Seats may be elastomer material.

F. Water Flow Balancing Valves: For flow regulation. Provide separate isolation valve. Valves shall be sized to provide the needed pressure drop in the middle of their throttling range.
   1. Ball style valve.
   2. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
   3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

G. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 28 to 393 kPa (4 to 57 psig). Provide standard pressure taps and 4 sets of capacity charts. Valves shall be line size and be one of the following designs:

1. Gray iron ASTM A126 or brass body rated 1200 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless-steel piston and spring.
2. Brass or ferrous body designed for 2070 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

2.8 STRAINERS

A. Basket Type.
   1. Screens: Bronze, Monel metal or 18-8 stainless-steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (1/8 inch) diameter perforations.

B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.9 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:
   1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
   2. Working pressures and temperatures shall be as follows:
      a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165 psig) at 121 degrees C (250 degrees F).
      b. Connector sizes 127 mm to 305 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).

B. Braided Hose: Corrugated-metal inner hose and braided outer shell.
   1. Piping Up To 50 mm (2 inches): Bronze hoses and single-braid bronze sheaths with 3102 kPa at 21 degrees C (450 psig at 70 degrees F) and 2344 kPa at 232 degrees C (340 psig at 450 degrees F) ratings.
   2. Piping From 65 mm (2-1/2 inches) To 100 mm (4 inches): Stainless-steel hoses and single-braid, stainless-steel sheaths with 2070 kPa at 21 degrees C (300 psig at 70 degrees F) and 1550 kPa at 232 degrees C (225 psig at 450 degrees F) ratings.

3. Piping From 150 mm (6 inches) and Above: Stainless-steel hoses and single-braid, stainless-steel sheaths with 1380 kPa at 21 degrees C (200 psig at 70 degrees F) and 1000 kPa at 315 degrees C (145 psig at 600 degrees F) ratings.

2.10 EXPANSION JOINTS

A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.

C. Bellows - Internally Pressurized Type:
   1. Multiple corrugations of Type 304 or Type A240-321 stainless-steel.
   2. Internal stainless-steel sleeve entire length of bellows.
   3. External cast-iron equalizing rings for services exceeding 345 kPa (50 psig).
   4. Welded ends.
   5. Design shall conform to standards of EJMA and ASME B31.9.
   6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
   7. Integral external cover.

D. Bellows - Externally Pressurized Type:
   1. Multiple corrugations of Type 304 stainless-steel.
   2. Internal and external guide integral with joint.
   3. Design for external pressurization of bellows to eliminate squirm.
   4. Welded ends.
   5. Conform to the standards of EJMA and ASME B31.9.
   6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
   7. Integral external cover and internal sleeve.

E. Expansion Compensators:
   1. Corrugated bellows, externally pressurized, stainless-steel or bronze.
   2. Internal guides and anti-torque devices.
   3. Threaded ends.
   4. External shroud.

5. Conform to standards of EJMA.

F. Expansion Joint (Contractor's Option): 2413 kPa (350 psig) maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 75 mm (3 inch).

G. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number in the contract documents.

H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides shall be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides shall be used if detailed in the contract documents.

I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.11 HYDRONIC SYSTEM COMPONENTS

A. Automatic Air Vent Valves: Where shown in the contract documents, cast-iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless-steel float, valve, valve seat and mechanism, minimum 13 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

2.12 THERMOMETERS

A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 152 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.

B. Case: Chrome plated brass or aluminum with enamel finish.

C. Scale: Not less than 228 mm (9 inches), range as described below, 2-degree graduations.

D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.

E. Scale Ranges:

1. Chilled Water and Glycol-Water: 0 to 38 degrees C (32 to 100 degrees F).
2. Hot Water and Glycol-Water: 38 to 93 degrees C (100 to 200 degrees F).

2.13 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

B. The contract documents show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location in the contract documents shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

E. Install piping generally parallel to walls and column center lines, unless shown otherwise in the contract documents. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted in the contract documents.

H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

I. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

J. Connect piping to equipment as shown in the contract documents. Install components furnished by others such as:

   1. Water treatment pot feeders.

K. Thermometer Wells: In pipes 63 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

L. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.

M. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder's qualification requirements in paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than 3 threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast-Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast-iron flange.

D. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints shall be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary to the satisfaction of the COR. Tests shall be either of those below, or a combination, as approved by the COR.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.

C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly

adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system, if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.

D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.6 WATER TREATMENT

A. Install water treatment equipment and provide water treatment system piping.

B. Close and fill system as soon as possible after final flushing to minimize corrosion.

C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

D. Utilize this activity, by arrangement with the COR, for instructing VA operating personnel.

3.7 ELECTRIC HEAT TRACING

A. Install tracing as recommended by the manufacturer.

B. Coordinate electrical connections.

3.8 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

D. Adjust red set hand on pressure gauges to normal working pressure.

3.9 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

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SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Steam, condensate, and vent piping inside buildings.

B. Boiler plant and outside steam distribution piping is covered in specification Section 33 63 00, STEAM ENERGY DISTRIBUTION and Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

C. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 09 91 00, PAINTING.

F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

I. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

L. Section 23 22 23, STEAM CONDENSATE PUMPS.

M. Section 23 25 00, HVAC WATER TREATMENT.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards shall govern.

B. American Society of Mechanical Engineers (ASME):

B1.20.1 ..... Pipe Threads, General Purpose (Inch)

B16.5 ..... Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9 ..... Factory Made Wrought Buttwelding Fittings

B16.11 ..... Forged Fittings, Socket-Welding and Threaded

B16.42 ..... Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300

B31.1 ..... Power Piping

B31.9 ..... Building Services Piping

B40.100 ..... Pressure Gauges and Gauge Attachments

ASME Boiler and Pressure Vessel Code (BPVC) -

BPVC Section II Materials

BPVC Section VIII Rules for Construction of Pressure Vessels, Division 1

BPVC Section IX Welding, Brazing, and Fusing Qualifications

C. American Society for Testing and Materials (ASTM):

A53/A53M..... Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M..... Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A216/A216M..... Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A193/194M ..... Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A194/194M ..... Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A285/A285M..... Standard Specification for Pressure Vessel Plates, Carbon Steel, Low-and Intermediate-Tensile Strength

A516/A516M..... Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A536 ..... Standard Specification for Ductile Iron Castings

B62 ..... Standard Specification for Composition Bronze or Ounce Metal Castings

D. American Welding Society (AWS):

B2.1/B2.1M ..... Specification for Welding Procedure and Performance Qualifications

Z49.1 .....Safety in Welding and Cutting and Allied Processes

E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-80 .....Bronze Gate, Globe, Angle, and Check Valves

F. Military Specifications (Mil. Spec.):

MIL-DTL-901E.....Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems

G. National Board of Boiler and Pressure Vessel Inspectors (NB):

Relieving Capacities of Safety Valves and Relief Valves

H. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards-2019 .....10th Edition

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 22 13, STEAM AND CONDENSATE HEATING PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Pipe and equipment supports.Submit calculations for variable spring and constant support hangers.
2. Pipe and tubing, with specification, class or type, and schedule.
3. Pipe fittings, including miscellaneous adapters and special fittings.
4. Flanges, gaskets and bolting.
5. Valves of all types.
6. Steam traps.
7. Steam trap monitoring system.
8. Strainers.
9. Pipe alignment guides.
10. Expansion joints.
11. Expansion compensators.

12. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
13. All specified steam system components.
14. Gauges.
15. Thermometers and test wells.
16. Electric heat tracing systems.
17. Seismic bracing details for piping.

D. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
   1. Heat Exchangers (Steam-to-Hot Water).
   2. Flash tanks.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
   1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
   2. One set of reproducible drawings.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. The products and execution of work specified in this section shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be

enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.

C. Welding Qualifications: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME BPVC Section IX, AWS Z49.1 and AWS B2.1/B2.1M.
   2. Comply with provisions in ASME B31.9 ASME B31.1.
   3. Certify that each welder and welding operator has passed AWS qualification tests for welding processes involved and that certification is current and recent. Submit documentation to the COR.
   4. All welds shall be stamped according to the provisions of the American Welding Society.

D. ASME Compliance: Comply with ASME B31.9 ASME B31.1 for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME labels.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be via electronic file transfer. One copy of operation and maintenance manuals shall be inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion

thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:

1. As-built drawings are to be provided, with a copy of them on AutoCAD version 2023 provided via electronic file transfer. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Steam Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40.

B. Steam Condensate and Pumped Condensate Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; or ASTM A106/A106M Grade B, seamless, Schedule 80.

C. Vent Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40, galvanized.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded.

1. Cast iron fittings or piping is prohibited for steam and steam condensate piping. Bushing reduction or use of close nipples is prohibited.

2. Forged steel, socket welding or threaded: ASME B16.11, 13,790 kPa (2000 psig) class with ASME B1.20.1 threads. Use Schedule 80 pipe and fittings for threaded joints. Lubricant or sealant shall be oil and graphite, or other compound approved for the intended service.
3. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class on piping 50 mm (2 inches) and less.
4. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.

B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
1. Cast iron fittings or piping is prohibited for steam and steam condensate piping.
2. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
3. Welding flanges and bolting: ASME B16.5:
a. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 400 degrees C (750 degrees F) and 10,342 kPa (1500 psig).
b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A193/193M, Class 2, Grade B7 for bolts and ASTM A194/194M for nuts.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.4 DIELECTRIC FITTINGS

A. Provide where dissimilar metal pipe are joined.
B. 50 mm (2 inches) and Smaller: Threaded dielectric union.
C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.
E. Contractor’s option: On pipe sizes 50 mm (2 inches) and smaller, screwed end steel gate valves or dielectric nipples may be used in lieu of dielectric unions.

2.5 VALVES

A. Asbestos packing is prohibited.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.1 meter (7 feet) or greater above the floor or operating platform.

D. Shut-Off Valves:

1. Ball Valves:

a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze wedges and Monel or stainless-steel seats, threaded ends, rising stem, and union bonnet.

b. 65 mm (2-1/2 inches) and larger: Flanged, outside screw and yoke.

1) High pressure steam 110 kPa (16 psig) and above system: Cast steel body, ASTM A216/A216M grade WCB, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.

2) All other services: Forged steel body, Class B, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze face wedge and seats, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.

E. Ball Valves: Reduced port permitted for bypass (throttling) service; full port required for all other services, one-fourth turn to open.

1. Type 501: Type 316 stainless steel body, ball and stem, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 4137 kPa at 93 degrees C (600 psig at 200 degrees F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends.

2. Type 502: Steel body, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 1724 kPa at 121 degrees C (250 psig at 250 degrees F), reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.

3. Type 503: Carbon steel body, steam service, rated for 1380 kPa at 200 degrees C (200 psig at 392 degrees F), stainless steel ball and stem, Polyfil seat, live-loaded or adjustable stem seal, threaded ends.

F. Globe and Angle Valves:
   1. Globe Valves:
      a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, and renewable seat rings.
      b. 65 mm (2-1/2 inches) and larger:
         1) Globe valves for high pressure steam 110 kPa (16 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
         2) All other services: Steel body, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.
   2. Angle Valves:
      a. 50 mm (2 inches) and smaller: Cast steel 1035 kPa (150 psig), union bonnet with metal plug type disc.
      b. 65 mm (2-1/2 inches) and larger:
         1) Angle valves for high pressure steam 110 kPa (16 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
         2) All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.
G. Swing Check Valves:
   1. 50 mm (2 inches) and smaller: Cast steel, 1035 kPa (150 psig), 45-degree swing disc.
   2. 65 mm (2-1/2 inches) and Larger:
      a. Check valves for high pressure steam 110 kPa (16 psig) and above system: Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
      b. All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.
H. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.6 STRAINERS

A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.

B. High Pressure Steam: Rated 1035 kPa (150 psig) saturated steam.

1. 50 mm (2 inches) and smaller: Cast steel, rated for saturated steam at 1034 kPa (150 psig) threaded ends.
2. 65 mm (2-1/2 inches) and larger: Cast steel rated for 1034 kPa (150 psig) saturated steam with 1034 kPa (150 psig) ASME flanged ends or forged steel with 1724 kPa (250 psig) ASME flanged ends.

C. All Other Services: Rated 861 kPa (125 psig) saturated steam.

1. 50 mm (2 inches) and smaller: Cast steel body.
2. 65 mm (2-1/2 inches) and larger: Flanged, cast steel body.

D. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:

1. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (1/8 inch) diameter perforations for liquids.

2.7 PIPE ALIGNMENT

Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides shall be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed in the contract documents.

2.8 EXPANSION JOINTS

A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

B. Minimum Service Requirements:

1. Pressure Containment:
   a. Steam Service 35-200 kPa (5-29 psig): Rated 345 kPa (50 psig) at 148 degrees C (298 degrees F).

b. Steam Service 214-850 kPa (31-123 psig): Rated 1035 kPa (150 psig) at 186 degrees C (366 degrees F).
c. Steam Service 869-1035 kPa (126-150 psig): Rated 1380 kPa (200 psig) at 194 degrees C (381 degrees F).
d. Condensate Service: Rated 690 kPa (100 psig) at 154 degrees C (309 degrees F).

2. Number of Full Reverse Cycles without failure: Minimum 1000.
3. Movement: As shown on contract documents plus recommended safety factor of manufacturer.

C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.

D. Bellows - Internally Pressurized Type:
1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
2. Internal stainless-steel sleeve entire length of bellows.
3. External cast iron equalizing rings for services exceeding 345 kPa (50 psig).
4. Welded ends.
5. Design shall conform to standards of EJMA and ASME B31.1.
6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
7. Integral external cover.

E. Bellows - Externally Pressurized Type:
1. Multiple corrugations of Type 304 stainless steel.
2. Internal and external guide integral with joint.
3. Design for external pressurization of bellows to eliminate squirm.
4. Welded ends.
5. Conform to the standards of EJMA and ASME B31.1.
6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
7. Integral external cover and internal sleeve.

F. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number in the contract documents.

2.9 FLEXIBLE BALL JOINTS

A. Design and Fabrication: One-piece component construction, fabricated from steel with welded ends, designed for a working steam pressure of 1725 kPa (250 psig) and a temperature of 232 degrees C (450 degrees F). Each joint shall provide for 360 degrees rotation in addition to a minimum angular flexible movement of 30 degrees for sizes 6 mm (1/4 inch) to 150 mm (6 inch) inclusive, and 15 degrees for sizes 65 mm (2-1/2 inches) to 762 mm (30 inches). Joints through 355 mm (14 inches) shall have forged pressure retaining members, while size 406 mm (16 inches) through 762 mm (30 inches) shall be of one-piece construction.

B. Material:

1. Cast or forged steel pressure containing parts and bolting in accordance with ASME BPVC Section II or ASME B31.1. Retainer may be ductile iron ASTM A536, Grade 65-45-12, or ASME BPVC Section II SA 515, Grade 70.
2. Gaskets: Steam pressure molded composition design for a temperature range of from minus 10 degrees C (50 degrees F) to plus 274 degrees C (525 degrees F).

C. Certificates: Submit qualifications of ball joints in accordance with the following test data:

1. Low pressure leakage test: 41 kPa (6 psig) saturated steam for 60 days.
2. Flex cycling: 800 Flex cycles at 3447 kPa (500 psig) saturated steam.
3. Thermal cycling: 100 saturated steam pressure cycles from atmospheric pressure to operating pressure and back to atmospheric pressure.
4. Environmental shock tests: Forward certificate from a recognized test laboratory, that ball joints of the type submitted has passed shock testing in accordance with Mil. Spec MIL-S-901.
5. Vibration: 170 hours on each of three mutually perpendicular axes at 25 to 125 Hz; 1.3 mm to 2.5 mm (0.05 inch to 0.10 inch) double amplitude on a single ball joint and 3 ball joint off set.

2.10 STEAM SYSTEM COMPONENTS

A. Safety Valves and Accessories: Comply with ASME BPVC Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown. Valve shall have stainless steel seats and trim.

B. Moisture Separator: Shall be of the high efficiency internal baffle type, with a pressure drop that does not exceed an equivalent length of straight pipe. Body shall be iron, steel or cast steel with

screwed, socket weld or flanged connections as detailed on drawing schedule. Steel construction shall be in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code with ASME Class 150, 300 or 600 RF flange connections. A bottom drain connection shall be provided for the installation of a trap to discharge any accumulated liquid. Separators shall be installed before steam PRV and Control Valves.

C. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 meter (200 feet) intervals on the horizontal main lines.
   1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated in the contract documents, traps shall be sized for capacities indicated at minimum pressure drop as follows:
      a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
      b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
   2. Trap bodies: Steel and stainless-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. The use of raised face flange is required on pipe sizes 1-1/2 inch and greater. The use of unions is acceptable for pipe sizes less than 1–1/2 inches. For systems without relief valve traps shall be rated for the pressure upstream of the steam supplying the system.
   3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or Monel metal.
   4. Valves and seats: Suitable hardened corrosion resistant alloy.
   5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
   6. Floats: Stainless steel.
   7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.
   8. Thermodynamic steam traps: Shall have tight shut-off with no steam loss allowed either by bleed or “controlled leak” and shall have an integral seat design with hardened disc and seating surfaces. Thermodynamic traps for steam pressures below 600 psi shall be all stainless-steel construction with threaded, socket weld or flanged connections on a common centerline, and shall be capable of operating in any position. Traps shall be capable of operating with up to 80% back pressure and shall be standard with insulating cover to

reduce heat loss. Thermodynamic traps for steam pressures 600 psi or higher shall be of alloy steel construction with threaded, socket weld or flanged connections on a common centerline, and will operate in any position. Steam trap shall be capable of operating with up to 80% back pressure with operating pressure up to 900 psi. Thermodynamic trap shall have three equidistant discharge ports between seat land surfaces to minimize disc and seat wear.

9.

2.11 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide steel, lever handle union cock. Provide steel or stainless-steel pressure snubber for gauges in water service. Provide steel pigtail syphon for steam gauges.

C. Pressure gauge ranges shall be selected such that the normal operating pressure for each gauge is displayed near the midpoint of each gauge's range. Gauges with ranges selected such that the normal pressure is displayed at less than 30 percent or greater than 70 percent of the gauge's range are prohibited. The units of pressure shall be psig.

2.12 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Provide one each of the following test items to the COR:

1. 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless steel pressure gauge adapter probe for extra-long test plug. Pressure/temperature plug is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 762 mm (30 inches) Hg to 690 kPa (100 psig) range.
3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (1 inch) dial, 125 mm (5 inch) long stainless-steel stem, plastic case.

2.13 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 GENERAL

A. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

B. The contract documents show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location in the contract documents shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

E. Install piping generally parallel to walls and column center lines, unless shown otherwise in the contract documents. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping and another surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 meter (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents.

G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted in the contract documents.

H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

I. Connect piping to equipment as shown in the contract documents. Install components furnished by others such as flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

K. Pipe vents to the exterior. Where a combined vent is provided, the cross-sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping 25 mm (1 inch) in 12 meter (40 feet) 0.25 percent in direction of flow. Provide a drip pan elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent minimum 300 mm (12 inches) above the roof or through the wall minimum 2.4 meter (8 feet) above grade with down turned elbow.

L. Contract documents do not identify all locations where steam trap sets are required. Contractor shall provide at no additional cost as many trap-sets as are necessary for the proper, reliable operation of the system. Provide trap-sets at all low points and at 61 meter (200 feet) intervals on all horizontal main lines.

3.2 WELDING

A. The contractor is entirely responsible for the quality of the welding and shall:

1. Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding operators have the ability to make sound welds under standard conditions.
2. Perform all welding operations required for construction and installation of the piping systems.

B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, AWS B2.1/B2.1M, AWS Z49.1, and also as outlined below.

C. Examining Welder: Examine each welder at job site, in the presence of the COR, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each

welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number assigned.

D. Examination Results: Provide the COR with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

E. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

F. Alignment: Provide approved welding method for joints on all pipes greater than 50 mm (2 inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.

G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. If the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (1 foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).

H. Non-Destructive Examination of Piping Welds:

1. Perform radiographic examination of 50 percent of the first 10 welds made and 10 percent of all additional welds made. The COR reserves the right to identify individual welds for which the radiographic examination shall be performed. All welds shall be visually inspected by the COR. The VA reserves the right to require testing on additional welds up to 100 percent if greater than 25 percent of the examined welds fail the inspection.
2. An approved independent testing firm regularly engaged in radiographic testing shall perform the radiographic examination of pipe joint welds. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.
3. Comply with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project. The COR and the CxA shall be given a copy of all reports to be maintained as part of the project records and shall review all inspection records.

I. Defective Welds: Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening are prohibited. Welders responsible for defective welds shall be requalified prior to resuming work on the project.

J. Electrodes: Electrodes shall be stored in a dry heated area and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

3.3 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1/B2.1M. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast Steel Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast steel flange.

3.4 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints shall be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.5 STEAM TRAP PIPING

A. Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (24 pounds) independently of connecting piping.

1. On pipe size 1-1/2 inch and greater a raised face flange is required to allow for removal of the steam trap without disturbing surrounding piping.
2. On pipe size less than 1-1/2inch raised face flanges or unions may be used to allow for removal of the traps.

3.6 SEISMIC BRACING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.7 LEAK TESTING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary to the satisfaction of the COR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

D. Prepare and submit test and inspection reports to the COR within 5 working days of test completion and prior to covering the pipe.

E. All tests shall be witnessed by the COR, their representative, or the CxA and be documented by each section tested, date tested, and list or personnel present.

3.8 FLUSHING AND CLEANING PIPING SYSTEMS

Steam, Condensate and Vent Piping: The piping system shall be flushed clean prior to equipment connection. Cleaning includes pulling all strainer screens and cleaning all scale/dirt legs during startup operation. Contractor shall be responsible for damage caused by inadequately cleaned/flushed systems.

3.9 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified

requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. Adjust red set hand on pressure gauges to normal working pressure.

- - - E N D - - -

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field refrigerant piping for direct expansion HVAC systems.

B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

C. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Definitions:

1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
   a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
   b. High side means the parts of a refrigerating system subjected to condenser pressure.
2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

C. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Section 23 07 11, HVAC INSULATION.

F. Section 23 21 13, HYDRONIC PIPING.

G. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT

H. Section 23 81 23, COMPUTER-ROOM AIR-CONDITIONERS

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. The contractor shall use the current editions at time of contract award. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):

495 .....Standard for Refrigerant Liquid Receivers

730 .....Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers

750 .....Thermostatic Refrigerant Expansion Valves

760 .....Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):

15 .....Safety Standard for Refrigeration Systems (ANSI)

17 .....Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)

34 .....Designation and Classification of Refrigerants (ANSI)

63.2 .....Method of Testing Liquid Line Filter Drier Filtration Capability (ANSI)

D. American National Standards Institute (ANSI):

A13.1 .....Scheme for Identification of Piping Systems

Z535.1 .....Safety Color Code

E. American Society of Mechanical Engineers (ASME):

B16.22 .....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)

B16.24 .....Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)

B31.5 .....Refrigeration Piping and Heat Transfer Components (ANSI)

B40.100 .....Pressure Gauges and Gauge Attachments

B40.200 .....Thermometers, Direct Reading and Remote Reading

F. American Society for Testing and Materials (ASTM)

A126 .....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

B32 .....Standard Specification for Solder Metal

B88 .....Standard Specification for Seamless Copper Water Tube

B88M.....Standard Specification for Seamless Copper Water Tube (Metric)

B280 .....Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

G. American Welding Society, Inc. (AWS): Brazing Handbook

A5.8/A5.8M.....Standard Specification for Filler Metals for Brazing and Braze Welding

H. Underwriters Laboratories (UL):

207 .....Standard for Refrigerant-Containing Components and Accessories, Nonelectrical

429 .....Standard for Electrically Operated Valves

I. Department of Veterans Affairs (VA):

PG-18-10 .....HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 23 00, REFRIGERAN PIPING”, with applicable paragraph identification.

C. Shop Drawings:

1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with in the contract documents for components noted below:

   a. Tubing and fittings

   b. Valves

   c. Strainers

   d. Moisture-liquid indicators

e. Filter-driers
f. Flexible metal hose
g. Liquid-suction interchanges
h. Oil separators (when specified)
i. Gauges
j. Pipe and equipment supports
k. Refrigerant and oil
l. Pipe/conduit roof penetration cover
m. Soldering and brazing materials

2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

D. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

E. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

D. Products shall comply with UL 207 "Refrigerant–Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

E. Categorize selected refrigerant with ASHRAE 34-2022. Submit selected refrigerant for information.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. For piping over 100 mm (4 inch) use A53 Black SML steel.

B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L).

C. Fittings, Valves and Accessories:

1. Copper fittings: Wrought copper fittings, ASME B16.22.
   a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
   b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
2. Steel fittings: ASTM wrought steel fittings.
   a. Refrigerant piping – Welded Joints.
3. Flanges and flanged fittings: ASME B16.24.
4. Refrigeration Valves:
   a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
   b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
   c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open holding coil.
   d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive nonferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.

e. Electronic Thermostatic Expansion Valves: Electronic thermal expansion valves shall be stepper motor high resolution drive assembly type for precision control. Valve shall not exceed 6 watts max consumption. Compatibility tested with most HC, CFC, HCFC, and HFC refrigerants and oils. Valve pistons and ports to be characterized to provide improved flow resolution and performance. Valves to be interfaced with microprocessor-based controllers by devise manufacturer with temperature feedback loop. Electric expansion valves to be sized with nominal steps of stroke for tonnage application as recommended by valve manufacture ranging from 500 steps on small tonnage (under 5 tons per circuit) to 6300 on large tonnage circuits (over 100 tons per circuit)

f. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.

5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines greater than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown in the contract documents. Conform to ARI Standard 730. Heavy gauge steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.
8. Water Piping Valves and Accessories: Refer to specification Section 23 21 13, HYDRONIC PIPING.
9. Oil Separators: Provide for condensing units, as shown. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it.

Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency. Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase, and shall have isolating stop valves so it can be opened and services without pumping out any other part of the system. ASME construction or UL listed.

2.2 GAUGES

A. Temperature Gauges: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gauges shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.

B. Vacuum and Pressure Gauges: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

1. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gauge) (250 psig).
2. Discharge: 0 to 3445 kPa (gauge) (0 to 500 psig).

2.3 THERMOMETERS AND WELLS

Refer to specification Section 23 21 13, HYDRONIC PIPING.

2.4 PIPE SUPPORTS

Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.5 REFRIGERANTS AND OIL

Provide EPA approved refrigerant and oil for proper system operation.

2.6 PIPE/CONDUIT ROOF PENETRATION COVER

A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer,38 mm (1-1/2 inch) thick, 48 kg/cubic meter (3 pounds/cubic foot) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck,

provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 38 mm (1-1/2 inch) thick mineral fiber board insulation.

C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.7 PIPE INSULATION FOR DX HVAC SYSTEMS

Refer to specification Section 23 07 11, HVAC INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5

1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown in the contract documents.
4. Use copper tubing in protective conduit when installed below ground.
5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

B. Joint Construction:

1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
   a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
   b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.

d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

D. Pipe relief valve discharge to outdoors for systems containing greater than 45 kg (100 lbs) of refrigerant.

E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.

F. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 PIPE AND TUBING INSULATION

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

B. Systems containing greater than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:

1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).

2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3. Signage and labeling identifying “flammable” or “health hazard” based on chosen refrigerant per requirements and definitions in ASHRAE 34-2022.

3.4 FIELD QUALITY CONTROL

A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of COR. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.

1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gauge on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

A. Ensure qualified workers are competent in the application of chosen refrigerant per ASHRAE 15 and ASHRAE 34. System Test and Charging: As recommended by the equipment manufacturer or as follows:

1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psig) gauge. Close valves and disconnect

refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gauge reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for 8 hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

3.6 STARTUP AND TESTING

A. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 7 days prior notice./

B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.7 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the CxA.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.8 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Ductwork and accessories for HVAC including the following:

1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.

C. Definitions:

1. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
2. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
3. Exposed Duct: Exposed to view in a finished room.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 07 84 00, FIRESTOPPING.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 22 11 00, FACILITY WATER DISTRIBUTION./

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

I. Section 23 07 11, HVAC INSULATION.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 34 00, HVAC FANS.

L. Section 23 40 00, HVAC AIR CLEANING DEVICES.

M. U. Section 23 82 16, AIR COILS.

N. Section 28 31 00, FIRE DETECTION and ALARM.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Civil Engineers (ASCE):

7 .....Minimum Design Loads for Associated Criteria for Buildings and Other Structures

C. American Society for Testing and Materials (ASTM):

A653/A653M.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A1011/A1011 .....Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B209 .....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C1071 .....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

E1 .....Standard Specification for ASTM Liquid-in-Glass Thermometers

E77 .....Standard Test Method for Inspection and Verification of Thermometers

E84 .....Standard Test Method for Surface Burning Characteristics of Building Materials

D. National Fire Protection Association (NFPA):

90A.....Standard for the Installation of Air-Conditioning and Ventilating Systems

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

006 .....HVAC Duct Construction Standards, Metal and Flexible, 4th Edition

016 .....HVAC Air Duct Leakage Test Manual, 2nd Edition

.....Fibrous Glass Duct Construction Standards, 7th Edition

F. Underwriters Laboratories, Inc. (UL):

181 .....Standard for Factory-Made Air Ducts and Air Connectors

555 .....Standard for Fire Dampers

555S .....Standard for Smoke Dampers

G. Department of Veterans Affairs (VA):

PG-18-10 .....Physical Security Design Manual for VA Mission Critical Facilities

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 31 00, HVAC DUCTS AND CASINGS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Rectangular Ducts:
   a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gauge and reinforcement.
   b. Duct liner.
   c. Sealants and gaskets.
   d. Access doors.
2. Round and Flat Oval DuctS:
   a. Manufacturer's details for duct fittings.
   b. Sealants and gaskets.
   c. Access sections.
   d. Installation instructions.
3. Volume dampers, back draft dampers.
4. Upper hanger attachments.
5. Fire dampers, fire doors, and smoke dampers with installation instructions.
6. Flexible ducts and clamps, with manufacturer's installation instructions.
7. Flexible connections.

8. Instrument test fittings.
9. Details and design analysis of alternate or optional duct systems.

D. Coordination Drawings: Refer to paragraph SUBMITTALS in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

C. Fire Safety Code: Comply with NFPA 90A.

D. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown in the contract documents.

F. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as he duct or provide at least the same level of corrosion resistance.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653/A653M, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.

B. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are prohibited because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

C. Approved factory-made joints may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:

B. Duct Pressure Classification:

1. 0 to 13 mm (0 to 1/2 inch)
2. 13 mm to 25 mm (1/2 inch to 1 inch)
3. 25 mm to 50 mm (1 inch to 2 inch)
4. 50 mm to 75 mm (2 inch to 3 inch)
5. 75 mm to 100 mm (3 inch to 4 inch)

C. Seal Class: All ductwork shall receive Class A Seal.

2. Rectangular Duct: Galvanized steel, minimum 1.0 mm (20 gauge), Pittsburgh lock seam, companion angle joints 32 mm by 3.2 mm (1-1/4 by 1/8 inch) minimum at no greater than 2.4 m (8 feet) spacing. Approved pre-manufactured joints are acceptable in lieu of companion angles.

D. Round Ducts: Furnish duct and fittings made by the same manufacturer to ensure good fit of slip joints. When submitted and approved in advance, round duct, with size converted on the basis

of equal pressure drop, may be furnished in lieu of rectangular duct design shown in the contract documents.

1. Elbows: Diameters 75 through 203 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards, Metal and Flexible.

E. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 508 mm (20 inches) wide by 1219 to 1372 mm (48 to 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

F. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA for Single Blade and Multi-blade Volume Dampers.

G. Duct Hangers and Supports: Refer to SMACNA Standards. Avoid use of trapeze hangers for round duct.

H. Ductwork in excess of 620 cm^2 (96 square inches) shall be protected unless the duct has one dimension less than 152 mm (6 inches) if it passes through the areas listed below. Refer to the Physical Security Design Manual for VA Mission Critical Facilities. This applies to the following:

1. Perimeter partitions of computer rooms

2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS

A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:

1. Each duct mounted coil.
2. Each fire damper (for link service), smoke damper and automatic control damper.
3. Each duct mounted smoke detector.

B. Openings shall be as large as feasible in small ducts, 305 mm by 305 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.

1. For Rectangular Ducts: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.
2. For Round Ducts: Refer to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

2.4 FIRE DAMPERS

A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2-hour rating, 70 degrees C (158 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

B. Fire dampers in wet air exhaust shall be of stainless-steel construction, all others may be galvanized steel.

C. Minimum Requirements for Fire Dampers:

1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gauge), required to provide installation equivalent to the damper manufacturer's UL test installation.
2. Submit manufacturer's installation instructions conforming to UL rating test.

2.5 SMOKE DAMPERS

A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 457 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch WG).

B. Leakage: Class I.

C. Maximum Air Leakage, Closed Damper: 0.32 cubic meters /min/square meter (4.0 cfm per square foot) at 750 Pa (3 inch WG) differential pressure.

D. Minimum Requirements for Dampers:

1. Shall comply with requirements of UL 555S, except for the Fire Endurance and Hose Stream Test.
2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
3. Blades: Galvanized steel, parallel type preferably, 305 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
4. Shafts: Galvanized steel.
5. Bearings: Nylon, bronze sleeve or ball type.

6. Hardware: Zinc plated.
7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See contract documents for required control operation.

E. Motor Operator (Actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.6 FLEXIBLE AIR DUCT

A. General: Factory-fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts greater than 203 mm (8 inches) in diameter shall be Class 1. Ducts less than 203 mm (8 inches) in diameter shall be Class 1 or Class 2.

C. Insulated Flexible Air Duct: Factory-fabricated including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 152 mm (6 inch) duct, of 762 m/min (2500 fpm).

D. Application Criteria:
1. Temperature Range: -18 to 93 degrees C (0 to 200 degrees F) internal.
2. Maximum Working Velocity: 1219 m/min (4000 fpm).
3. Minimum Working Pressure, Inches of Water Gauge: 2500 Pa (10 inches WG) positive, 500 Pa (2 inches WG) negative.

E. Duct Clamps: 100 percent nylon strap, 80 kg (176 pounds) minimum loop tensile strength manufactured for this purpose or stainless-steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

F. Flexible air duct is prohibited in operating room suites, SPS processing spaces, Pharmacy compounding spaces, Protective Environment spaces, Isolation Rooms, Clean Rooms, Bio-containment Laboratories, Research Laboratories, and Clinical Laboratories.

2.7 FLEXIBLE DUCT CONNECTIONS

Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 822 g (29 ounces) neoprene coated fiberglass fabric approximately 152 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless-steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to ensure that no vibration is transmitted.

2.8 PREFABRICATED ROOF CURBS

Galvanized steel or extruded aluminum 305 mm (12 inches) above finish roof service, continuous welded corner seams, treated wood nailer, 38 mm (1-1/2 inch) thick, 48 kg/cubic meter (3 pound/cubic feet) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

2.9 FIRESTOPPING MATERIAL

Refer to Section 07 84 00, FIRESTOPPING.

2.10 SEISMIC RESTRAINT FOR DUCTWORK

Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

2.11 DUCT MOUNTED TEMPERATURE SENSOR (AIR)

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.12 INSTRUMENT TEST FITTINGS

A. Manufactured type with a minimum 50 mm (2 inch) length for insulated duct, and a minimum 25 mm (1 inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

2.17 AIR FLOW CONTROL VALVES (AFCV)

A. Refer to Section 23 36 00, AIR TERMINAL UNITS and Section 23 82 00, CONVECTION HEATING and COOLING UNITS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

C. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:

1. Contract documents show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes in the contract documents are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

D. Install duct hangers and supports in accordance with SMACNA Standards.

E. Install fire dampers and smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers and smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and

where required by the COR. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate resetting of fire dampers and operation of smoke dampers to the COR.

F. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

G. Flexible Duct Installation: Refer to SMACNA Standards. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long per NFPA 90A, as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hours. Support ducts SMACNA Standards.

H. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

I. Control Damper Installation:

1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

J. Air Flow Measuring Devices: Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.

K. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by COR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and

painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.

B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections.

C. Test procedure, apparatus and report shall conform to SMACNA HVAC Air Duck Leakage Test Manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.

D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.

E. All tests shall be performed in the presence of the COR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COR and identify leakage source with excessive leakage.

F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the COR.

G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3 TESTING, ADJUSTING, AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.4 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Fans for heating, ventilating and air conditioning.

C. Product Definitions: AMCA 99.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

G. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Movement and Control Association International, Inc. (AMCA):

99 .....Standards Handbook

210 .....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

300 .....Reverberant Room Method for Sound Testing of Fans

C. American Society for Testing and Materials (ASTM):

B117 .....Standard Practice for Operating Salt Spray (Fog) Apparatus

D1735.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus

D3359.....Standard Test Methods for Rating Adhesion by Tape Test

G152.....Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of NonMetallic Materials

G153.....Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of NonMetallic Materials

D. National Fire Protection Association (NFPA):

NFPA 96.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. National Sanitation Foundation (NSF):

37 .....Air Curtains for Entranceways in Food and Food Service Establishments

F. Underwriters Laboratories, Inc. (UL):

181 .....Standard for Factory-Made Air Ducts and Air Connectors

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 34 00, HVAC FANS”, with applicable paragraph identification.

C. Manufacturers Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Plenum fan, motors, and drives.
2. Centrifugal fans, motors, drives, accessories, and coatings.
   a. Inline centrifugal fans.
   b. Tubular Centrifugal Fans.

D. Certified sound power levels for each fan.

E. Motor ratings, types, electrical characteristics, and accessories.

F. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

H. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

I. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Fans and power ventilators shall bear the AMCA performance seal.

B. Operating Limits for Centrifugal Fans: AMCA 99 (Class I, II, and III).

C. Fans and power ventilators shall comply with the following standards:

1. Testing and Rating: AMCA 210.
2. Sound Rating: AMCA 300.

D. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

D. Performance Criteria:

1. The fan schedule shall show the design air volume and static pressure. Select the fan motor hp by increasing the fan bhp by 10 percent to account for the drive losses and field conditions.
2. Select the fan operating point as follows:
   a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
   b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency.

E. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.

F. Corrosion Protection:

1. Except for fans in fume hood exhaust service, all steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturer's paint and paint system shall meet the minimum requirements of ASTM D1735 water fog, ASTM B117 salt spray, ASTM D3359 adhesion, and ASTM G152 and ASTM G153 for carbon arc light apparatus for exposure of non-metallic material.

G. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

H. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. Record factory vibration test results on the fan or furnish to the Contractor.

B. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.

1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 13 mm (1/2 inches) wire mesh screens for fan inlets without duct connections.
2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 50,000 hours, and an average fatigue life of 200,000 hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.
5. Belts: Oil resistant, non-sparking and non-static.

6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 hp, fixed pitch for use with motors greater than 15 hp. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Provide protective sheet metal enclosure for fans located outdoors. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for specifications.
9. Furnish variable speed fan motor controllers where shown in the contract documents. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for controller/motor combination requirements.

C. Inline Centrifugal Fans: Provide minimum 18 Gauge galvanized steel housing with inlet and outlet flanges, backward inclined aluminum centrifugal fan wheel, bolted access door and supports as required. Motors shall be factory pre-wired to an external junction box. Provide factory wired disconnect switch.

D. Tubular Centrifugal Fans: Provide hot rolled steel, one-piece design housing incorporating integral guide vanes, motor mounts, bolted access hatch and end flanges. Provide spun inlet bell and screen for unducted inlet and screen for unducted outlet. Provide welded steel, flanged inlet and outlet cones for ducted connection. Provide mounting legs or suspension brackets as required for support. Guide vanes shall straighten the discharge air pattern to provide linear flow.

E. Industrial Fans: Use where scheduled or in lieu of centrifugal fans for low volume high static service. Provide material handling flat blade type fan wheel.

F. Utility Fans, Vent Sets and Small Capacity Fans: Class l design, arc welded housing, spun intake cone. Requirement for AMCA seal is waived for wheel diameters less than 300 mm (l2 inches) and housings may be cast-iron.

G. Spark Resistant/Explosion Proof Fans: If flammable gas, vapor, or combustible dust is present in concentrations above 20 percent of the Lower Explosive Limit (LEL), provide AMCA construction option: A, B or C as indicated. Drive set shall be comprised of non-static belts for use in an explosive atmosphere. Motor shall be explosion proof type if located in air stream.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Install fan, motor and drive in accordance with manufacturer's instructions.

C. Align fan and motor sheaves to allow belts to run true and straight.

D. Bolt equipment to curbs with galvanized lag bolts.

E. Install vibration control devices as shown in the contract documents and specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.

B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.

C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 STARTUP AND TESTING

A. Verify operation of motor, drive system and fan wheel according to the contract documents.

B. Check vibration and correct as necessary for air balance work.

B. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air Outlets and Inlets: Diffusers, registers, and grilles.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 08 90 00, LOUVERS and VENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Duct Council:
Flexible Duct Performance & Installation Standards (Manual), 5th Edition Green Book

C. American Society of Civil Engineers (ASCE):
7 ..... Minimum Design Loads and Associated Criteria for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM):
B209/B209M ..... Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. National Fire Protection Association (NFPA):

90A .....Standard for the Installation of Air-Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):

181 .....Standard for Factory-Made Air Ducts and Air Connectors

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 37 00, AIR OUTLETS AND INLETS", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Diffusers, registers, grilles, and accessories.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

1.5 QUALITY ASSURANCE

A. Fire Safety Code: Comply with NFPA 90A.

B. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

C. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPORTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 AIR OUTLETS AND INLETS

A. Materials:

1. Steel or aluminum
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless-steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Performance Test Data: In accordance with Air Duct Council "Flexible Duct Performance & Installation Standards (Manual), Green Book". Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT for NC criteria.

Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the contract drawings. Provide plaster frame for units in plaster ceilings.

a. Square, Louver, Fully Adjustable Pattern: Round neck, surface mounting unless shown otherwise on the contract drawings. Provide equalizing or control grid and volume control damper.

b. Louver Face Type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.

c. Perforated Face Type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have

the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.

d. Slot diffuser/plenum:

1) Diffuser: Frame and support bars shall be constructed of heavy gauge extruded aluminum. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.

2) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. The internal lining shall be factory-fabricated, anti-microbial, and non-friable.

3) Provide inlet connection diameter equal to duct diameter shown on the contract drawings or provide transition coupling if necessary. Inlet duct and plenum size shall be as recommended by the manufacturer.

4) Maximum pressure drop at design flow rate: 37 Pa (0.15 inch WG)

e. HEPA Filter Laminar Flow Diffuser:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the contract drawings. Provide plaster frame for units in plaster ceilings.

2. Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES for HEPA filter information.

1. Margin Frame: Flat, 19 mm (3/4 inch) wide.

2. Bars: Minimum 5 mm (3/16 inch) wide by 19 mm (3/4 inch) deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 3.2 mm (1/8 inch) on center. Reinforce bars on 457 mm (18 inch) center for sidewall units and on 152 mm (6 inch) center for units installed in floor or sills.

3. Provide opposed blade damper and equalizing or control grid where shown.

    1. Supply Grills: Double deflection type with horizontal face bars.

        a. Margin: Flat, 32 mm (1-1/4 inches) wide.

        b. Bar Spacing: 19 mm (3/4 inch) maximum.

C. Finish: Off white baked enamel for ceiling mounted units.

    1. Jet Diffusers: Aluminum construction (nozzle and frame) suitable for wall or ceiling mounting or direct mounting on ducts.

D. Return and Exhaust Registers and Grilles:

    1. Finish: Off-white baked enamel for ceiling mounted units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.

C. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by COR. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 TESTING, ADJUSTING, AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.3 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

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SECTION 23 40 00
HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Air filters for heating, ventilating and air conditioning.

C. Definitions: Refer to ASHRAE 52.2 for definitions of face velocity, net effective filtering area, media velocity, initial resistance (pressure drop), MERV (Minimum Efficiency Reporting Value), PSE (Particle Size Efficiency), particle size ranges for each MERV number, dust holding capacity and explanation of electrostatic media based filtration products versus mechanical filtration products. Refer to ASHRAE 52.2 for definition of MERV-A.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

850-2013 ..... Performance Rating of Commercial and Industrial Air Filter Equipment

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

52.2 .....Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

170 .....Ventilation of Health Care Facilities

D. American Society of Mechanical Engineers (ASME):

ASME Boiler and Pressure Vessel Code -

BPVC Section IX.....Welding, Brazing, and Fusing Qualifications

E. American Welding Society (AWS):

D9.1/D9.1M .....Sheet Metal Welding Code

F. International Organization for Standardization (ISO):

9001 .....Quality Management Systems - Requirements

G. Underwriters Laboratories, Inc. (UL):

586 .....Standard for High-Efficiency, Particulate, Air Filter Units

900 .....Standard for Air Filter Units

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 40 00, HVAC AIR CLEANING DEVICES”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Extended surface filters.
2. Holding frames. Identify locations.
3. Side access housings. Identify locations, verify insulated doors.
4. HEPA filters.
5. Magnehelic gauges.
6. Carbon Filters.

D. Air Filter performance reports.

E. Suppliers warranty.

F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

1.5 QUALITY ASSURANCE

A. Air Filter Performance Report for Extended Surface Filters:
   1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE 52.2 for type filter under test and acceptable to COR, indicating that filters comply with the requirements of this specification. Filters utilizing partial or complete synthetic media will be tested in compliance with pre-conditioning steps as stated in ASHRAE 52.2. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) face dimension. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.
   2. Government Option: The Government at its option may take one of the filters for each different type submitted and run an independent test to determine if the filter meets the requirements of this specification. When the filter meets the requirements, the Government will pay for the test. When the filter does not meet the specification requirements, the manufacturer will be required to pay for the test and replace the filters with filters that will perform as required by the specifications.
   3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be required to maintain the minimum efficiency shown on the ASHRAE 52.2 report throughout the time the filter is in service. Within the first 6 to 12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.
B. Filter Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no additional cost or time to the Government.

C. Comply with UL 900 for flame test.

D. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL classification, and file number.

E. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

F. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS. Provide one complete set of additional filters to the COR.

B. The COR will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the contaminant load limit is reached as indicated by maximum (final) pressure drop.

B. Filter Classification: UL listed and approved conforming to UL 900.

C. HVAC Filter Types:

HVAC Filter Types				
MERV Value ASHRAE 52.2		Application	Particle Size	Thickness /Type
8		Pre-Filter	3 to 10 Microns	50 mm (2 inch)

				Throwaway
11		After-Filter	1 to 3 Microns	152 mm (6 inch) or 305 mm (12 inch) Rigid Cartridge
13		(Alternate) After-Filter	0.3 to 1 Microns	152 mm (6 inch) or 305 mm (12 inch) Rigid Cartridge
14		After-Filter	0.3 to 1 Microns	152 mm (6 inch) or 305 mm (12 inch) Rigid Cartridge

D. HEPA Filters:

HEPA Filters				
Efficiency at 0.3 Micron	Application	Initial Resistance (inches WG)	Rated cfm	Construction
99.97	Final Filter	1.35	1100	Galvanized Frame X-Body
99.97	Final Filter	1.00	2000	Aluminum Frame V-Bank

2.3 MEDIUM EFFICIENCY PLEATED PANEL PRE-FILTERS (50 MM (2 INCH); MERV 8; UL 900 CLASS 2)

A. Construction: Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic or 100 percent virgin synthetic media, self-supporting media with required media stabilizers, and beverage board enclosing frame. Filter media shall be lofted to a uniform depth and formed into a uniform radial pleat. The media stabilizers shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

B. Performance: The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE 52.2. The media shall maintain or increase in efficiency over the life of the filter. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) face dimension.

Minimum Efficiency Reporting (MERV)	8

Dust Holding Capacity (Grams)	105
Nominal Size (Inches Width x Height x Depth)	24x24x2
Rated Air Flow Capacity (cfm)	2,000
Rated Air Flow Rate (fpm)	500
Final Resistance (Inches WG) Maximum Recommended Change-Out Resistance (Inches WG)	1.0 0.66
Rated Initial Resistance (Inches WG)	0.33

C. The filters shall be approved and listed by Underwriters Laboratories, Inc. as Class 2 when tested according to UL 900.

2.4 HIGH EFFICIENCY EXTENDED SURFACE (INTERMEDIATE/AFTER (FINAL)) CARTRIDGE FILTERS (305 MM (12 INCH); MERV 14/13/11; UL 900 CLASS 2)

A. Construction: Air filters shall consist of 8 pleated media packs assembled into 4 V-banks within a totally plastic frame. The filters shall be capable of operating at temperatures up to 80 degrees C (176 degrees F). The filters shall either fit without modification or be adaptable to the existing holding frames. The molded end panels are to be made of high impact polystyrene plastic. The center support members shall be made of ABS plastic. No metal components are to be used.

B. Media: The media shall be made of micro glass fibers with a water repellent binder. The media shall be a dual density construction, with coarser fibers on the air entering side and finer fibers on the air leaving side. The media shall be pleated using separators made of continuous beads of low profile thermoplastic material. The media packs shall be bonded to the structural support members at all points of contact, this improves the rigidity as well as eliminates potential air bypass in the filter.

C. Performance: Filters of the size, air flow capacity and nominal efficiency (MERV) shall meet the following rated performance specifications based on the ASHRAE 52.2 test method. All testing is to be conducted on filters with a nominal 610 mm by 610 mm (24 inch by 24 inch) header dimension.

Minimum Efficiency Reporting Value (MERV)	14	13	11
Gross Media Area (sf) Dust Holding Capacity (Grams)	197 486	197 430	197 465
Nominal Size (Inches Width x Height x Depth)	24x24x12	24x24x12	24x24x12

Rated Air Flow Capacity (cfm)	2,000	2,000	2,000
Rated Air Flow Rate (fpm)	500	500	500
Final Resistance (Inches WG) Maximum Recommended Change-Out Resistance (Inches WG)	2.0 0.74	2.0 0.68	2.0 0.54
Rated Initial Resistance (Inches WG)	0.37	0.34	0.27

2.5 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS STANDARD CAPACITY (FINAL FILTER APPLICATION)

A. Air filters shall be HEPA grade standard capacity air filters with waterproof micro glass fiber media, corrugated aluminum separators, urethane sealant, 1.6 mm (16 gauge) steel enclosing frame and fluid sealing gasket. Sizes shall be as noted on enclosed drawings or other supporting materials.

B. Construction: Filter media shall be one continuous pleating of microfine glass fiber media. Pleats shall be uniformly separated by corrugated aluminum separators incorporating a hemmed edge to prevent damage to the media. The media pack shall be potted into the enclosing frame with a fire-retardant urethane sealant. The enclosing frame shall be of 1.6 mm (16 gauge) steel, with a zinc aluminum alloy finish, and shall be bonded to the media pack to form a rugged and durable enclosure. The filter shall be assembled without the use of fasteners to ensure no frame penetrations. Overall dimensional tolerance shall be correct within -3.2 mm (-1/8 inch), +0 mm (+0 inch), and square within 3.2 mm (1/8 inch). A poured-in-place seamless sealing gasket shall be included on the downstream side of the enclosing frame to form a positive seal upon installation.

C. Performance: The filter shall have a tested efficiency of 99.97 percent when evaluated according to IEST Recommended Practice. Initial resistance to airflow shall not exceed 250 Pa (1 inch WG) at rated capacity. Filter shall be listed by Underwriters Laboratories as UL 900. The filter shall be capable of withstanding 2500 Pa (10 inches WG) without failure of the media pack. Manufacturer shall provide evidence of facility certification to ISO 9001.

HEPA Performance (Standard Capacity)		
Nominal Size (Inches Height x Width x Depth)	Airflow Capacity (cfm)	Media Area (sf)
24x24x12	1080 at 1 Inch WG	153
24x12x12	500 at 1 Inch WG	33

Follow manufacturer's recommendation for change out resistance, typically double the initial.

D. Supporting Data: The filter shall be labeled as to tested efficiency, rated/tested cfm, pressure drop and shall be serialized for identification. The manufacturer shall supply a Certificate of Conformance for each HEPA filter supplied to the facility.

2.6 HEPA FILTERS HIGH CAPACITY V-BANK HIGH CAPACITY FILTERS (FINAL FILTER APPLICATION)

A. Air filters shall be absolute grade HEPA filters consisting of pleated media packs assembled in a V-bank configuration, polyurethane sealant, anodized aluminum enclosure and seamless fluid sealing gasket. Sizes shall be as noted on enclosed drawings or other supporting materials.

B. Construction: Filter media shall be micro fiber glass formed into mini-pleat pleat-in-pleat V-bank design. The media packs shall be potted into the enclosing frame with fire retardant polyurethane sealant. An enclosing frame of anodized extruded aluminum shall form a rugged and durable enclosure. A seamless sealing gasket shall be included on the downstream side of the filter to form a positive seal upon installation.

C. Performance: Filter efficiency at 0.3 micron shall be 99.99 percent when evaluated according to the IEST Recommended Practice for applicable type. Each filter shall be labeled as to tested performance. Initial resistance target shall not exceed 250 Pa (1 inch WG) at rated airflow.

HEPA Performance V-Bank Style (High Capacity)		
Nominal Size (Inches Height x Width x Depth)	Airflow Capacity (cfm)	Media Area (sf)
24x24x12	2000 at 1 Inch WG	390
24x12x12	900 at 1 Inch WG	174
Follow manufacturer's recommendation for change out resistance, typically double the initial.		

D. Supporting Data: The filter shall be labeled as to tested efficiency, rated/tested cfm, pressure drop and shall be serialized for identification. The manufacturer shall supply a Certificate of Conformance for each HEPA filter supplied to the facility.

E. Filter shall be listed as UL 586 and UL 900 per Underwriters Laboratories. Manufacturer shall provide evidence of facility certification to ISO 9001.

2.7 FILTER HOUSINGS/SUPPORT FRAMES

A. Side Servicing Housings (HVAC Grade):

1. Filter housing shall be two-stage filter system consisting of 1.6 mm (16 gauge) galvanized steel enclosure, aluminum filter mounting track, universal filter holding frame, insulated dual-access doors, static pressure tap, filter gaskets and seals. Inline housing depth shall not exceed 533 mm (21 inches). Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: The housing shall be constructed of 1.6 mm (16 gauge) galvanized steel with pre-drilled standing flanges to facilitate attachment to other system components. Corner posts of Z-channel construction shall ensure dimensional adherence. The housing shall incorporate the capability of two stages of filtration without modification to the housing. A filter track, of aluminum construction shall be an integral component of housing construction. The track shall accommodate a 50 mm (2 inch) deep prefilter, a 152 mm (6 inch) or 305 mm (12 inch) deep rigid final filter, or a pocket filter with header. Insulated dual access doors, swing-open type, shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable positive sealing UV-resistant star-style knobs and replaceable door hinges. A universal holding frame constructed of 1.3 mm (18 gauge) galvanized steel, equipped with centering dimples, multiple fastener lances, and polyurethane filter sealing gasket, shall be included to facilitate installation of high-efficiency filters. The housing shall include a pneumatic pressure fitting to allow the installation of a static pressure gauge to evaluate pressure drop across a single filter or any combination of installed filters.
3. Performance: Leakage at rated airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1 percent at 750 Pa (3 inches WG). Leakage in to or out of the housing shall be less than one half of 1 percent at 750 Pa (3 inches WG). Accuracy of pneumatic pressure fitting, when to evaluate a single-stage, or multiple filter stages, shall be accurate within ± 3 percent at 150 Pa (0.6 inch WG).
4. Manufacturer shall provide evidence of facility certification to ISO 9001.

B. Holding Frame System (HVAC Grade):

1. Air filter-holding frames shall be 1.6 mm (16 gauge) galvanized steel with filter sealing flange, centering dimples, sealing gasket and lances for appropriate air filter fasteners. Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: Filter holding frame shall be constructed of 1.6 mm (16 gauge) galvanized steel. The frame shall be assembled from two corner sections and welded to assure a rigid

and durable frame assembly. The frame shall include a variety of pre-punched lances for filter fastener attachment. Fastener shall be capable of being installed without the use of tools, nuts or bolts. Lance penetrations shall be upstream of filter flange to assure leak-free integrity. The frame shall include filter-centering dimples on each frame wall to facilitate ease of filter installation and assure filter centering against filter sealing flange. A 19 mm (3/4 inch) filter-sealing flange shall be an integral component of the holding frame. All corners shall be flush mitered and a permanently mounted polyurethane foam gasket shall be mounted on the sealing flange to assure filter to frame sealing integrity.

3. Manufacturer shall provide evidence of facility certification to ISO 9001.

C. Side-Access Housing (HEPA Grade):

1. Filter housing shall be two-stage filter system consisting of 1.9 mm (14 gauge) galvanized steel enclosure, spring-loaded crank-type sealing assembly for gasket seal type final filters, insulated dual-access doors with gasketing and positive sealing doorknobs. Inline housing depth shall not exceed 635 mm (25 inches). Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: The housing shall be constructed of 1.9 mm (14 gauge) galvanized steel with mating flanges to facilitate attachment to other system components. All pressure boundaries shall be of all welded construction. The housing shall be weatherproof and suitable for rooftop/outdoor installation. A prefilter track to accommodate nominal 50 mm (2 inch) deep prefilters, shall be an integral component of the housing. The housing shall incorporate a spring-loaded crank-type final filter sealing mechanism. The mechanism shall be geared to exert 700 pounds of pressure against each filter. The clamping frame shall have a continuous flat surface seal to compress all four downstream gasketed surfaces of the downstream seal filter. The final filter locking mechanism shall include a 19 mm (3/4 inch) socket adapter to facilitate opening or closing the mechanism. Insulated dual access doors shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable UV-resistant positive sealing knobs. The access doors shall be both hinged for swing open operation or designed to be completely removable. The housing shall include static pressure ports 3.2 mm (1/8 inch NPT male) to facilitate pressure drop measurements across prefilter, final filter, or combination thereof.
3. Performance: Manufacturer shall provide evidence of facility certification to ISO 9001.

D. Built-Up Bank HEPA Holding Frames:

1. Holding frames shall be constructed of 1.9 mm (14 guage) galvanized steel. Frames shall be welded and include centering dimples, pre-drilled mounting holes, filter sealing flange and swing bolt assemblies. An appropriate number of swing bolts to match air filters shall also be included. Sizes shall be as noted on enclosed drawings or other supporting materials.
2. Construction: Filter frame shall be all-welded construction of 1.9 mm (14 guage) galvanized steel. The frame shall include pre-drilled mounting holes to align frame-to-frame and ensure built-up bank support. Annular based centering dimples shall be an integral component to assist in proper seating of filter gasket to filter sealing flange. Assembly holes shall be within dimples to recess assembly bolts. Filter securing swing bolt assemblies, of the same construction as the frame, shall be offset to facilitate multiple filter installations. The assembly shall include appropriate swing bolts to match filter depth and equi-bearing clamps to allow uniform filter gasket sealing.
3. Performance: The sealing assembly shall be capable of sealing each element with 1680 mm/kg (30 inch/lbs.) of torque to 50 percent filter gasket compression. Manufacturer shall provide evidence of facility certification to ISO 9001.

E. Bag-In/Bag-Out HEPA Air Filter Housing:

1. Housing shall be side-access bag-in/bag-out, fluid seal housing. The housing shall be adequately reinforced to withstand a negative or positive pressure of 3736 Pa (15 inches WG). Housing design and filter arrangement shall allow air to enter and exit housing without changing direction. The housing shall accommodate standard size filters that do not require any special attachments or devices to function properly in the housing. The housing shall accommodate fluid seal filters which require a penetrating knife edge installed on all filter sealing surfaces. The knife edge shall insert into the fluid filled perimeter channel located on the face of the filter. By engaging the filter seal/release mechanism the filter shall move (push) the fluid filled channel to the sealed position. For removal of the air filters the filter seal/release mechanism shall remove (pull) the filter free of the blade type knife edge. This entire process is performed from inside the filter change out bag.
2. Construction:
   a. Housing shall be constructed of 1.9 mm (14 gauge) and 3.2 mm (11 gauge) T-304 stainless-steel metal. All pressure retaining joints and seams shall be continuously welded with no porosities. Joints and seams requiring intermittent welds, such as

reinforcement members, shall be intermittently welded. Housing shall be free of burrs and sharp edges. All weld joints and seams that are a portion of any gasket setting surface, and duct connection flanges, shall be ground smooth and flush with adjacent base metals. All welded joints and seams shall be wire brushed to remove heat discoloration. The housing shall be reinforced to withstand a positive or negative pressure of 3736 Pa (15 inches WG). The upstream and downstream ductwork connections shall have 38 mm (1-1/2 inch) outward-turned flanges.

b. The housing shall have a bagging ring around each filter access port that is sealed by a gasketed filter access door. The filter access door gasket shall be silicone and shall be replaceable, if necessary. The bagging ring shall have two (2) continuous formed raised ridges to secure the PVC change-out bag. The bagging ring shall be hemmed on the outer edge to prevent the change-out bag from tearing.

c. Ancillary hardware including filter seal/release mechanism, door handles, door studs and labels shall be 300 series stainless-steel. Filter access door knobs shall be cast aluminum and designed to prevent galling of threads.

d. One (1) PVC change-out bag shall be furnished with each filter access port. Change-out bags shall be 8-mil. thick with a yellow translucent, non-sticking, matte finish. It shall include a 6 mm (1/4 inch) diameter elastic shock cord hemmed into the opening of the bag so when stretched around the housing bagging ring flange, a secure fit is created. The bag shall include three (3) integral glove ports to assist in filter change-out. One (1) nylon security strap shall be included per filter access port to prevent the bag from sliding off the bagging flange during the change-out process. Design of components shall be such that all change-out operations shall be within the bag so there is a barrier between the worker and the filter at all times.

3. Performance: All welding procedures, welders, and welder operators shall be qualified in accordance with ASME BPVC Section IX. All production welds shall be visually inspected by qualified personnel, incorporating the workmanship acceptance criteria described in AWS D9.1/D9.1M.

4. The filter housing shall be factory tested for filter fit, alignment of filter sealing knife edge and operation of filter clamping mechanism. The filter sealing surface shall be tested at +2500 Pa (+10 inches WG) and have a maximum leak rate of 0.0005 cfm per cubic foot of

housing volume. The overall system pressure boundary shall be leak tested at +2500 Pa (+15 inches WG) and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume.

5. Filter bags shall be capable of continuous operating to temperature extremes of -18°C to 65°C (0°F to 150°F).
6. Multi-wide housing shall be equipped with a filter removal rod to pull the filters to the change-out position. The removal rod shall operate from the inside of the filter change out bag.
7. Manufacturer shall provide evidence of facility certification to ISO 9001.

F. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G.

2.8 INSTRUMENTATION

A. Magnehelic Differential Pressure Filter Gauges: Nominal 100 mm (4 inch) diameter, 0 to 500 Pa (0 to 2 inches WG), 3 inch for HEPA range, except for MERV 17 HEPA final filters, where the range shall be 0 to 750 Pa (0 to 3 inches WG). Gauges shall be flush-mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment.

B. DDC Static (Differential) Air Pressure Measuring Station: Refer to Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.

D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

2.9 HVAC EQUIPMENT FACTORY FILTERS

A. Manufacturer standard filters within fabricated packaged equipment should be specified with the equipment and should adhere to industry standard.

B. Cleanable filters are prohibited.

C. Automatic roll type filters are prohibited.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Install supports, filters, and gauges in accordance with manufacturer's instructions.

C. Label clearly with words "Contaminated Air" on exhaust ducts leading to the HEPA filter housing.

3.2 STARTUP AND TESTING

A. Clean and vacuum air handling units and plenums prior to starting air handling systems.

B. Replace pre-filters and install clean filter units prior to final inspection as directed by the COR.

C. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

E. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

- - - E N D - - -

SECTION 23 81 00A
DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies split-system air conditioners.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:

1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
4. Where such equipment is provided in greater than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 03 30 00, CAST-IN-PLACE CONCRETE.

E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

F. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

G. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

H. Section 23 07 11, HVAC INSULATION.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 23 00, REFRIGERANT PIPING.

L. Section 23 31 00, HVAC DUCTS and CASINGS.

M. Section 23 81 23, COMPUTER-ROOM AIR-CONDITIONERS.

N. Section 23 82 16, AIR COILS.

O. Section 28 31 00, FIRE DETECTION and ALARM.

1.3 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT", with applicable paragraph identification.

C. Manufacturer's literature and data Including:

1. Sufficient information, including capacities, pressure drops, and piping connections clearly presented, shall be included to determine compliance with contract documents for units noted below:

   a. Unitary air conditioners:

      1) Split systems

2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.

3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.

4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.

D. Certification: Submit proof of specified ARI Certification.

E. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, integrated energy efficiency ratio (IEER), and coefficient of performance (COP).

F. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to COR three weeks prior to final inspection.

G. Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.4 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

1.5 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

210/240.....PERFORMANCE RATING OF UNITARY AIR-CONDITIONING AND AIR-SOURCE HEAT PUMP EQUIPMENT

270 .....SOUND RATING OF OUTDOOR UNITARY EQUIPMENT

310/380.....STANDARD FOR PACKAGED TERMINAL AIR-CONDITIONERS AND HEAT PUMPS (CSA-C744-04)

340/360.....PERFORMANCE RATING OF COMMERCIAL AND INDUSTRIAL UNITARY AIR-CONDITIONING AND HEAT PUMP EQUIPMENT

520 .....PERFORMANCE RATING OF POSITIVE DISPLACEMENT CONDENSING UNITS

C. Air Movement and Control Association (AMCA):

210 .....LABORATORY METHODS OF TESTING FANS FOR AERODYNAMIC PERFORMANCE RATING (ANSI)

410 .....RECOMMENDED SAFETY PRACTICES FOR USERS AND INSTALLERS OF INDUSTRIAL AND COMMERCIAL FANS

D. American National Standards Institute (ANSI):

S12.51 .....ACOUSTICS - DETERMINATION OF SOUND POWER LEVELS OF NOISE SOURCES USING SOUND PRESSURE - PRECISION METHOD FOR REVERBERATION ROOMS (SAME AS ISO 3741:1999)

E. American Society of Civil Engineers (ASCE)

ASCE 7 .....MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES

F. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

HANDBOOK .....HVAC SYSTEMS AND EQUIPMENT

15 .....SAFETY STANDARD FOR REFRIGERATION SYSTEMS (ANSI)

34 .....DESIGNATION AND CLASSIFICATION OF REFRIGERANTS (ANSI)

62.1 .....VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY (ANSI)

G. American Society of Testing and Materials (ASTM):

B117 .....STANDARD PRACTICE FOR OPERATING SALT SPRAY (FOG) APPARATUS

H. Military Specifications (Mil. Specs.):

MIL-PRF-26915D .....PRIMER COATING, FOR STEEL SURFACES

I. National Electrical Manufacturer's Association (NEMA):

ICS 1.....INDUSTRIAL CONTROLS AND SYSTEMS: GENERAL REQUIREMENTS

MG 1.....MOTORS AND GENERATORS (ANSI)

J. National Fire Protection Association (NFPA) Publications:

90A .....STANDARD FOR THE INSTALLATION OF AIR-CONDITIONING AND VENTILATING SYSTEMS

K. Department of Veterans Affairs (VA):

PG-18-10 .....HVAC DESIGN MANUAL

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph “AS-BUILT DOCUMENTATION” in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 UNITARY AIR CONDITIONERS - GENERAL

A. Applicable ARI Standards:

1. Cooling Capacity Less Than 39.6 kW (135,000 Btu/hour): AHRI 210/240. Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.

C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated casings.

D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust beyond 3 mm (1/8-inch) on both sides from the scratch mark

2.2 SPLIT-SYSTEM AIR CONDITIONERS

A. Description: Factory assembled and tested, wall-mounted unit, with an air cooled remote condensing unit, and field-installed refrigeration piping.

B. Wall-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
5. Fan: Direct drive, centrifugal fan.
6. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
7. Condensate Pump: Demand controlled with digital sensor, bracket mounting, 120 V.
8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

C. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gauge ports shall be brass and located outside of the casing.

2. Compressor: Hermetically sealed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant: Use refrigerant type R-32 as listed in https://www.epa.gov/snap/. Submit selected refrigerant for government approval.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 degrees C (0 degrees F).
9. Mounting Base: Prefabricated light weight concrete equipment base pad for ground mounted units.
10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Rooftop Unit Support: Install unit level on structural curbs/ pilings . Coordinate wall penetrations and flashing with wall construction. Secure rooftop units to structural support with anchor bolts.

B. Install wind restraints according to manufacturer's written instructions. Wind restrained vibration isolation roof-curb rails are specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

C. Install units level and plumb maintaining manufacturer’s recommended clearances and tolerances.

D. Install water-cooled units with thermometer and pressure gauge at the water supply and return connection.

E. Install vibration spring isolators under base of self-contained unit, with minimum static deflection of 25 mm (1 inch) unless otherwise indicated. Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT

F. Install ground-mounted, compressor-condenser equipment and components on prefabricated light weight concrete mounting base. Secure equipment to base. Prepare ground surface to ensure equipment mounting base is installed level and is secure. Install per manufacturer's requirements.

G. Install roof mounted equipment on seismic rated equipment stand. Secure equipment stand to structure. Secure equipment to equipment stand. Coordinate with general contractor for roof insulation cutting and patching for stand installation.

H. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

I. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

3.2 CONNECTIONS

A. Verify condensate drainage requirements.

B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

C. Install piping adjacent to units to allow service and maintenance.

D. Ground equipment and install power wiring, switches, and controls for self-contained and split systems.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP AND TESTING

A. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 7 days prior notice.

B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the CxA.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

---END---

SECTION 23 81 23
COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies process cooling split systems air conditioning unit.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions:

1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
2. Integrated Energy Efficiency Ratio (IEER): Calculated by weighting the EER values at different load capacities and adding them together. The formula is based in the approximate number of hours a unit spends at each load point throughout its life. A minimum of four loads points are used for the calculation.
3. Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
4. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
5. CRAC Units: Computer Room Air Conditioning Units.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON–STRUCTURAL COMPONENTS.

E. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING./

F. Section 22 11 00, FACILITY WATER DISTRIBUTION.

G. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

H. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

I. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

J. Section 23 05 93: TESTING, ADJUSTING, and BALANCING FOR HVAC.

K. Section 23 07 11, HVAC INSULATION.

L. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

M. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

N. Section 23 21 13, HYDRONIC PIPING.

O. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.

P. Section 23 23 00, REFRIGERANT PIPING.

Q. Section 23 31 00, HVAC DUCTS and CASINGS.

R. Section 23 40 00, HVAC AIR CLEANING DEVICES.

1.3 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 81 23, COMPUTER-ROOM-AIR-CONDITIONERS”, with applicable paragraph identification.

C. Manufacturer’s Literature and Data Including: Rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.

1. Indoor Air Conditioning Unit
2. Glycol Pump Package
3. Dry Cooler
4. Air Cooled Condensing Unit

D. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.

E. Submit wiring diagrams for power, alarm and controls.

F. Certification: Submit, simultaneously with shop drawings, a proof of certification:

G. Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

H. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.4 QUALITY ASSURANCE

Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.5 GUARANTEE

The unit shall be guaranteed against all mechanical defects in material, parts or workmanship and shall be repaired or replaced at the Contractor's expense within the period of one year from final acceptance. Contractor shall adhere to a four-hour service response time to troubles during the guarantee period.

1.6 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:

210/240.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment

340/360.....Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment

410 .....Forced-Circulation Air-Cooling and Air-Heating Coils

460 .....Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers

520 .....Performance Rating of Positive Displacement Condensing Units

DCPP (Web-based).....Directory of Certified Product Performance - Applied Directory of Certified Products

C. Air Movement and Control Association (AMCA):

210 .....Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (ANSI)

410 .....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans

D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE):

15 .....Safety Standard for Refrigeration Systems

34 .....Designation and Classification of Refrigerants (ANSI)

52.1withdrawn).....Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices used in General Ventilation for Removing Particulate Matter

62-1 .....Ventilation for Acceptable Indoor Air Quality (ANSI)

90.1 .....Energy Standard for Buildings except Low-Rise Residential Buildings (ANSI Approved; IES Co-sponsored)

.....HVAC Systems and Equipment Handbook

.....Refrigeration Handbook

E. American Society of Testing and Materials (ASTM):

B117 .....Standard Practice for Operating Salt Spray (Fog) Apparatus

F. National Electrical Manufacturer's Association (NEMA):

MG 1.....Motors and Generators (ANSI)

G. National Fire Protection Association (NFPA) Publications:

70 .....National Electrical Code

90A .....Standard for the Installation of Air-Conditioning and Ventilating Systems

H. Department of Veterans Affairs (VA):

PG-18-10 .....HVAC Design Manual

1.7 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 CONSOLE UNITS

A. Description: Split system consisting of evaporator section for floor or wall mounting and remote condensing section.

B. Evaporator Cabinet: Furniture-grade steel with baked-enamel finish; with front access and containing direct-drive centrifugal fans and two-speed motor.

C. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

D. Condenser Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

E. Compressor: Semi Hermetic scroll, variable speed with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.

F. Refrigeration Circuit: Filter/dryer, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

G. . EPA approved refrigerants are listed at https://www.epa.gov/snap/. Submit proposed refrigerant for government approval.

H. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.

   1. Mount coil assembly over stainless-steel drain pancomplying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

I. Remote Air-Cooled Refrigerant Condenser: Integralaluminum-fin coil with plenum fan, direct driven.

J. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

K. Filter: Disposable, glass-fiber media.

   1. Arrestance: 90 percent according to ASHRAE 52.1.
   2. MERV Rating: 7 according to ASHRAE 52.2.

L. Electrode Steam Humidifier: Self-contained and microprocessor controlled; with replaceable cylinder.

M. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

N. Control System: Unit-mounted panel with contactors, control transformer with circuit breaker, and solid-state temperature control modules. Wall-mounted control panel shall be solid-state, with start-stop switch and adjustable temperature set point.

O. DDC or BAS Interface: Provide connection to the DDC or the BAS system.

2.2 FAN MOTORS

A. Default motor characteristics are specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC.

B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

D. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 SPECIAL TOOLS

If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory.

2.4 CORROSION CONTROL

A. Remote Outdoor Condenser Coils:

1. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
   a. Salt Spray Resistance (Minimum 6,000 Hours)
   b. Humidity Resistance (Minimum 1,000 Hours)
   c. Water Immersion (Minimum 260 Hours)
   d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
   e. Impact Resistance (Up to 160 Inch/Pound)

B. Exposed Outdoor Cabinet

1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.

B. Coordinate installation of Computer room Air Conditioning Units with Computer room access flooring installer.

C. Field Refrigerant Piping: As specified in specification Section 23 23 00, REFRIGERANT PIPING.

D. Field Piping: Glycol Piping and Condensate Piping, as specified in specification Section 23 21 13, and HYDRONIC PIPING.

E. Fill glycol system with 40 percent glycol mixture and perform start-up procedures as recommended by the manufacturer.

F. Electrical System Connections and Equipment Ground: As specified in Division 26 Sections.

3.2 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to machine to allow service and maintenance.

D. Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING. Provide adequate connections for condensate drain.

E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00, REFRIGERANT PIPING. Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. After startup service and performance test, change filters and flush humidifier.

3.4 STARTUP AND TESTING

A. The CxA and COR will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 7 days prior notice.

B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.5 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the CxA.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for4hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - - -

SECTION 23 81 43
AIR-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies electrically operated air-source unitary heat pumps.

B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

C. Definitions**:**

1. Coefficient of Performance (COP) - Cooling: The ratio of the rate of heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

D. Coefficient of Performance (COP) - Heating: The ratio of the rate of heat delivered to the rate of energy input is consistent units for a complete heat pump system, including the compressor and, if applicable, auxiliary heat under designated operating conditions.

E. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions.

F. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.

G. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.

H. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON–STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

H. Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

J. Section 23 23 00, REFRIGERANT PIPING.

K. Section 23 31 00, HVAC DUCTS AND CASINGS.

1.3 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

C. Comply with ASHRAE Standard 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI 210/240AHRI 340/360 and UL 1995.

D. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI 210/240AHRI 340/360 and UL 1995.

E. Comply with requirements in Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

1.4 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer’s Literature and Data Including:

C. Air-Source Unitary Heat pump:

D. Packaged units

E. Split system

F. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.

G. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.

H. Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.5 APPLICABLE PUBLICATIONS

***NOTE: FROM THE DATE CONTRACT DOCUMENTS ARE PROVIDED, THE CONTRACTOR SHALL USE THE MOST CURRENT PUBLISHED VERSIONS OF ALL LISTED STANDARDS AND REFERENCES BELOW.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Federal Specification (Fed. Spec.):

A-A-50502 ..... AIR-CONDITIONER (UNITARY HEAT PUMP), AIR TO AIR (3000 TO 300,000 BTUH)

C. Air-Conditioning Heating and Refrigeration Institute (AHRI) Standards:

DCPP(WEB-BASED)..... DIRECTORY OF CERTIFIED PRODUCT PERFORMANCE - APPLIED DIRECTORY OF CERTIFIED PRODUCTS

210/240..... PERFORMANCE RATING OF UNITARY AIR-CONDITIONING AND AIR-SOURCE HEAT PUMP EQUIPMENT

270 ..... SOUND RATING OF OUTDOOR UNITARY EQUIPMENT

310/380..... STANDARD FOR PACKAGED TERMINAL AIR-CONDITIONERS AND HEAT PUMPS (CSA-C744-04)

340/360..... COMMERCIAL AND INDUSTRIAL UNITARY AIR-CONDITIONING AND HEAT PUMP EQUIPMENT

D. Air Movement and Control Association (AMCA):

210 ..... LABORATORY METHODS OF TESTING FANS FOR AERODYNAMIC PERFORMANCE RATING (ANSI)

410 ..... RECOMMENDED SAFETY PRACTICES FOR USERS AND INSTALLERS OF INDUSTRIAL AND COMMERCIAL FANS

E. American National Standards Institute (ANSI):

S12.51 ..... ACOUSTICS - DETERMINATION OF SOUND POWER LEVELS OF NOISE SOURCES USING SOUND PRESSURE - PRECISION METHOD FOR REVERBERATION ROOMS (SAME AS ISO 3741:1999)

F. American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc. (ASHRAE):

15 .....SAFETY STANDARD FOR REFRIGERATION SYSTEMS (ANSI)

62.1 .....VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY (ANSI)

90.1 .....ENERGY STANDARD FOR BUILDINGS EXCEPT LOW-RISE RESIDENTIAL BUILDINGS

.....HVAC SYSTEMS AND EQUIPMENT HANDBOOK

G. American Society of Testing and Materials (ASTM):

B117 .....STANDARD PRACTICE FOR OPERATING SALT SPRAY (FOG) APPARATUS

D4587.....STANDARD PRACTICE FOR FLUORESCENT UV-CONDENSATION EXPOSURES OF PAINT AND RELATED COATINGS

H. National Electrical Manufacturer's Association (NEMA):

ICS 1.....INDUSTRIAL CONTROLS AND SYSTEMS: GENERAL REQUIREMENTS

MG 1.....MOTORS AND GENERATORS (ANSI)

I. National Fire Protection Association (NFPA):

90A .....STANDARD FOR THE INSTALLATION OF AIR-CONDITIONING AND VENTILATING SYSTEMS

J. Underwriters Laboratory (UL):

1995 .....HEATING AND COOLING EQUIPMENT

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 UNITARY HEAT PUMPS, AIR TO AIR

A. Units shall comply with Fed Spec A-A-50502Type I, having factory assembled refrigerant circuit or circuits (Packaged Unit), Type II, (Split System) having remote outdoor section separate from indoor Section, Class 1, "Department of Energy" (DOE) covered products (units with cooling capacity up to 65000 Btu/hr Class 2, Non–DOE covered products (units with cooling capacity up to 300,000 Btu/hr .

B. Unitary heat pumps shall bear the United States Environmental Protection Agency, Energy Star label and shall have a minimum Heating Season Performance Factor (HSPF) of 8 (Type I –

Packaged Unit),8.2 (Type II – Split System), and a minimum Seasonal Energy Efficiency Ratio (SEER) of 14 (Type I – Packaged Unit),14.5 (Type II – Split System).

C. Applicable AHRI Standards: Units shall be listed in the corresponding ARI Directory of Certified products shown in paragraph, APPLICABLE PUBLICATIONS:

D. Air Source Unitary heat pumps with capacity less than 65,000 Btu/hr, Comply with AHRI 210/240.

E. Air Source heat pump with capacity above above 65,000 Btu/hr, Comply with AHRI 340/360.

F. Casing: Unit shall be constructed of zinc coated, heavy-gage 14-gage minimum galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit surfaces shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with 1/2–inch 1-inch 2-inch matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. The base of the unit shall have provisions for forklift and crane lifting.

G. Filters: One inch, MERV 7, throwaway filter shall be standard on all units below 6 Tons. Filter rack can be converted to two-inch capability. Two inch, MERV 8, throwaway filters shall be factory supplied on all units above 6 Tons.

H. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors.

I. Refrigerant Circuit: A minimum of two circuits is required. Each refrigerant circuit shall have independent fixed orifice or thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.

J. Evaporator and Condenser Coils: Internally finned, DN 10 (NPS 3/8) copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporated coil and condenser coil shall be leak tested at the factory to 200 psig and pressure tested to 400 psig. All dual compressor units shall have intermingled evaporator coils. Sloped condensate drain pans shall be provided.

K. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.

L. Indoor Fan:

M. Forward-Curved, Centrifugal Fan: Provide V-belt driven with adjustable motor sheaves adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves. Motors shall be thermally protected. Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT).

N. Plenum Fans Provide direct-drive, Arrangement 4, plenum fan(s) equipped with variable-speed drives. Maximum fans in an array shall not exceed four.

O. Defrost Controls: A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 10 to 20 tons. Adaptive demand defrost shall be provided on units below 35 kW (10 Tons).

P. Unit Electrical

Q. Provide single point unit power connection.

R. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.

S. Safety Controls - High pressure, low temperature, and low-pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically be interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.

T. Operating Controls

U. Provide unit with low voltage electric controlsfactory supplied DDC control system.

V. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch(heat-off-cool)(off-heat-auto-cool)and fan control switch (auto-on).

W. Unit DDC Controller:

X. Unit controller shall include input, output and self-contained programming as needed for complete control of unit.

Y. Unit controller shall be BAC net compliant and utilize BAC net operating protocol.

Z. Control system shall seamlessly interface with temperature control system as specified in Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC without requiring gateways or any other interface devices.

AA. All program sequences shall be stored on board in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of logic controller shall be completely modifiable in the field over installed BACnet LANs.

BB. Temperature Control System Interface: Points shall be available from the unit controller for service access and display and/or control.

CC. Space Temperature Sensor: The wall mounted sensor shall include occupied and unoccupied setpoint control, pushbutton unoccupied override, space temperature offset and space temperature indication. Refer to Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC for additional requirements.

DD. Accessories:

EE. Electric Heater: Constructed of heavy-duty nickel chromium elements. Staging shall be achieved through the unit control processor. Each heater shall have automatically reset high limit control. Heaters shall be individually fused from the factory and shall comply with NEC and CEC requirements. Power assemblies shall provide single point connection. Electric heat modules shall be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls shall confirm the supply fan is operating before electric elements are energized. Operate electric heater in 23 stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.

FF. Economizer: Down flow Horizontal flow; field factory installed; and shall include fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting and fixed dry bulb. Solid state enthalpy and differential enthalpy control shall be field-installed .

GG. Oversized Motors: Factory Field installed over sized motor shall be available for high-static application.

2.2 CORROSION PROTECTION

A. Remote Outdoor Condenser Coils:

B. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be

maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:

C. Salt Spray Resistance (Minimum 6,000 Hours)
D. Humidity Resistance (Minimum 1,000 Hours)
E. Water Immersion (Minimum 260 Hours)
F. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
G. Impact Resistance (Up to 160 Inch/Pound)
H. Exposed Outdoor Cabinet:
I. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance ASTM D4587-11(2019)e.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
B. Install heat pumps according to manufacturers printed instructions.
C. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with Division 26 Sections.
D. Ductwork: Comply with requirements in Section 23 31 00, HVAC DUCTS AND CASINGS.
E. Piping: Comply with requirements in Section 23 23 00, REFRIGERANT PIPING.

3.2 STARTUP AND TESTING

A. Perform startup checks according to manufacturer's written instructions.

B. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 7 working days prior to startup and testing.

C. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the COR.

D. Furnish test reports to the COR in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the CxA.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - - -

SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. This section specifies room fan-coil units and

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

K. Section 23 21 13, HYDRONIC PIPING.

L. Section 23 31 00, HVAC DUCTS and CASINGS.

M. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. Air-Conditioning, Heating, and Refrigeration Institute (ANSI/AHRI):

440 ..... Performance Rating of Fan-Coil Units

C. National Fire Protection Association (NFPA):

70 ..... National Electrical Code

90A .....Standard for the Installation of Air-Conditioning and Ventilating Systems

D. Underwriters Laboratories, Inc. (UL):

181 .....Standard for Factory-Made Air Ducts and Air Connectors

1995 .....Heating and Cooling Equipment

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 82 00, Convection Cooling and Heating Units”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Room Fan-Coil units.

D. Certificates:

1. Compliance with paragraph QUALITY ASSURANCE.
2. Compliance with specified standards.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

F. Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

G. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Refer to paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide guarantee in accordance with FAR clause 52.246-21.

B. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

C. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 ROOM FAN-COIL UNITS

A. Capacity Certification: AHRI 440.

B. Safety Compliance: NEC compliant and UL listed.

C. Noise Levels: Operating at full cooling capacity, sound power level shall not exceed by more than 5 dB the numerical value of sound pressure levels associated with noise criteria specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Select units at intermediate speed, for compliance with the noise criteria.

D. Chassis: Galvanized steel, acoustically and thermally insulated to attenuate noise and prevent condensation.

E. Cabinet: Minimum 1.3 mm (l8 gauge) steel reinforced and braced. Arrange components and provide adequate space for installation of piping package and control valves. Finish shall be factory-baked enamel in manufacturer's standard color on all exposed surfaces.

1. Vertical Exposed Cabinet Unit: Provide 1.6 mm (l6 gauge) steel front panel with 13 mm (l/2 inch) thick fiberglass insulation and provide screw-type levelers. Provide low-silhouette type where shown.

a. Air Outlet Grilles: Adjustable four-way air deflection located in the top panel.

b. Provide two hinged access doors (one each side) equipped with key operated cam-lock fasteners in the unit top panel located to provide access to the unit controls.

F. Fans: Centrifugal, forward curved, double width type wheels, galvanized steel or polyester resin construction, statically and dynamically balanced, direct driven.

1. Motors: Premium efficiency, 3-speed permanent split capacitor type with integral thermal overload protection, for operation at no greater than l200 RPM.
2. Provide a fan speed selector switch, with off, low, medium, and high positions. Switch shall have a set of auxiliary contacts which are open when the switch is in the “off” position and closed when the switch in any of the other positions. On vertical units, mount switch in a junction box in the cabinet of each unit. On ceiling-suspended horizontal and concealed units, switch shall be wall mounted

G. Cooling Coils:

1. Hydronic: Copper tubes, 10 mm (3/8 inch) minimum inside diameter, not less than 0.43 mm (0.0l7 inch) thick with copper or aluminum fins. Coils shall be pressure tested for bursting and strength in accordance with Underwriters Laboratories, Inc., requirements for pressure tested coils, and shall be designed to provide adequate heat transfer capacity. Provide manual air vent at high point of each coil and drain at each low point.

H. Piping Package: Factory furnished with unit by the manufacturer or field-installed by the contractor to fit control valves provided by the controls’ supplier. Submit manufacturer’s detailed drawings of the piping in the end compartments for approval prior to fabrication of the piping packages. Provide ball stop valves on the supply and return pipes and balancing fittings on the return pipes.

I. Drain Pans: Furnish galvanized steel with solderless drain connections and molded polystyrene foam insulating liner:

1. Auxiliary Drain Pan: Located under control valve and piping within the unit enclosure to prevent dripping.
2. Secondary Drain Pan: Where the unit is located such that drain pan overflow will damage the building provide a secondary drain pan located provided with a separate drain line discharging to conspicuous point.

J. Air Filter: Manufacturer's standard throwaway type, not less than 25 mm (1 inch) thick, MERV 7, supported to be concealed from sight and be tight fitting to prevent air by-pass. Filters shall have slide out frames and be easily replaced without removing enclosure or any part thereof.

K. Control valves and remote wall mounted space thermostats are to be field installed. Provide two-way modulating control valves unless shown or specified otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

C. Handle and install units in accordance with manufacturer's written instructions.

D. Support units rigidly so they always remain stationary. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

E. Install fiberglass blanket insulation with a minimum R value of 8 above hydronic radiant panels.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior o startup and testing.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hour to instruct each VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - - -

SECTION 23 82 16
AIR COILS

PART 1 - GENERAL

1.1 DESCRIPTION

A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Heating and cooling coils for air handling units and duct applications.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEMS for HVAC.

I. Section 23 31 00, HVAC DUCTS AND CASINGS.

N. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

1.3 APPLICABLE PUBLICATIONS

***Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. The contractor shall use the current editions at time of contract award. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Conditioning and Refrigeration Institute (AHRI):
Directory of Certified Applied Air Conditioning Products
AHRI 4l0- .....Forced-Circulation Air-Cooling and Air-Heating Coils

C. American Society for Testing and Materials (ASTM):
B75/75M .....Standard Specifications for Seamless Copper Tube

D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

15 .....Safety Standard for Refrigeration Systems

34 .....Designation and Classification of Refrigerants (ANSI)

E. National Electric Manufacturers Association (NEMA):

250 .....Enclosures for Electrical Equipment (1,000 Volts Maximum)

F. National Fire Protection Association (NFPA):

70 .....National Electric Code

G. Underwriters Laboratories, Inc. (UL):

1996 .....Electric Duct Heaters

H. Department of Veterans Affairs (VA):

PG-18-10 .....HVAC Design Manual

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 82 16, AIR COILS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Submit type, size, arrangements, and performance details. Present application ratings in the form of tables, charts, or curves.

D. Provide installation, operating and maintenance instructions.

E. Certification Compliance: Evidence of listing in current AHRI Directory of Certified Applied Air Conditioning Products.

F. Coils may be submitted with Section 23 36 00, AIR TERMINAL UNITS, Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

H. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

1.5 QUALITY ASSURANCE

A. Refer to paragraph QUALITY ASSURANCE of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with AHRI 4l0 and shall bear the AHRI certification label.

C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

D. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING COILS

A. Conform to ASTM B75/75M and AHRI 410.

B. Tubes: Minimum 0.625 inch tube diameter; Seamless copper tubing.

C. Fins: 0.0055 inch aluminum or 0.0045 inch copper mechanically bonded or soldered or helically wound around tubing.

D. Headers: Copper, welded steel or cast-iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.

E. "U" Bends, Where Used: Machine die-formed, silver brazed to tube ends.

F. Coil Casing: 1.6 mm (l6 gauge) galvanized steel with tube supports at 1219 mm (48 inch) maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.

G. Pressures PSIG:

Pressure	Water Coil		Refrigerant Coil
Test	300		300
Working	200		250

H. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.

I. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.

2.2 WATER COILS, INCLUDING GLYCOL-WATER

A. Use the same coil material as listed in paragraph HEATING AND COOLING COILS.

B. Drainable Type (Self-Draining, Self-Venting); Manufacturer Standard:

1. Cooling, all types.
2. Heating or preheat.
3. Runaround energy recovery. AHRI certification of capacity adjustment is waived. See Section 23 72 00, AIR-TO-AIR ENERGY RECOVERY EQUIPMENT.

C. Cleanable Tube Type; Manufacturer Standard:

1. Well water applications.
2. Wastewater applications.

2.4 VOLATILE REFRIGERANT COILS

A. Continuous circuit, straight tubes, dry expansion type equipped with multi-port distribution header, less expansion valve.

B. Minimum 16 mm (5/8 inch) tube diameter.

C. EPA approved refrigerants are listed at https://www.epa.gov/snap/. Submit proposed refrigerant for government approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.

B. Follow coil manufacturer's instructions for handling, cleaning, installation, and piping connections.

C. Comb fins, if damaged. Eliminate air bypass or leakage at coil sections.

3.2 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum of 10 working days prior to startup and testing.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel responsible in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.

C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.

D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.

B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
   a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Are periodically inspected by a NRTL.
   c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:

1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.

B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new and shall have superior quality and freshness.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer and witnessed by the contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels, and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
   1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
   2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
   3. Damaged equipment shall be repaired or replaced, as determined by the COR.
   4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
   5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the Contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:

1. Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.
3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the COR, and Medical Center's Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR, and Medical Center's Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.
5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the COR, and Medical Center's Chief Engineer or his/her designee to witness the work.

D. For work that affects existing electrical systems, arrange, phase, and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

E. New work shall be installed and connected to existing work neatly, safely, and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit, and raceways.

D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:

1. Nominal system voltage.
2. Equipment/bus name, date prepared, and manufacturer name and address.
3. Arc flash boundary.
4. Available arc flash incident energy and the corresponding working distance.

5. Minimum arc rating of clothing.
6. Site-specific level of PPE.

1.12 SUBMITTALS

A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.

C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.

3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
4. For all electrical distribution equipment including, but not limited to, switchgear, switchboards, panelboards, transformers, disconnects / switches, ATSs, and generators, provide plan view sketch(es) and, if necessary, elevation details, of the proposed equipment layout(s) indicating all electrical clearances will be met. All sketches shall be dimensioned.

F. Maintenance and Operation Manuals:
1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation instructions.
   e. Safety precautions for operation and maintenance.
   f. Diagrams and illustrations.
   g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
   h. Performance data.

i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

H. After approval and prior to installation, furnish the COR with one sample of each of the following:

1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
2. Each type of conduit coupling, bushing, and termination fitting.
3. Conduit hangers, clamps, and supports.
4. Duct sealing compound.
5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.15 ACCEPTANCE CHECKS AND TESTS

A. The Contractor shall furnish the instruments, materials, and labor for tests.

B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer’s representatives and technicians so that a complete, functional, and operational system is delivered to the Government.

C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment and repeat the tests for the equipment. Repair, replacement, and re-testing shall be accomplished at no additional cost to the Government.

1.16 WARRANTY

A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.17 INSTRUCTION

A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.

B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.

C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings and insulation type for each conductor and cable.
      2) Splicing materials and pulling lubricant.
2. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

B. American Society of Testing Material (ASTM):

D2301-10.....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

D2304-10.....Test Method for Thermal Endurance of Rigid Electrical Insulating Materials

D3005-10.....Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Electrical Manufacturers Association (NEMA):

WC 70-09.....Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-14 .....Thermoset-Insulated Wires and Cables

83-14 .....Thermoplastic-Insulated Wires and Cables

467-13 .....Grounding and Bonding Equipment

486A-486B-13 .....Wire Connectors

486C-13 .....Splicing Wire Connectors

486D-15.....Sealed Wire Connector Systems

486E-15 .....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-07 .....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

514B-12 .....Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. No. 8 AWG and larger: Stranded.
3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

D. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
   a. Solid color insulation or solid color coating.
   b. Stripes, bands, or hash marks of color specified.
   c. Color using 19 mm (0.75 inches) wide tape.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit “switch legs”, and 3-way and 4-way switch “traveling wires,” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.

7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:

1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.
4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.

D. Above Ground Splices for 250 kcmil and Larger:

1. Long barrel “butt-splice” or “sleeve” type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

E. Underground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:

1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations and approved for copper and aluminum conductors.

2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.

B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

D. Push-in style connectors are strictly prohibited.

2.4 CONTROL WIRING

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

A. Lubricating compound shall be suitable for the wire insulation and conduit and shall not harden or become adhesive.

B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

B. Install all conductors in raceway systems.

C. Splice conductors only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.

I. Conductor and Cable Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
2. Use nonmetallic pull ropes.
3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
4. All conductors in a single conduit shall be pulled simultaneously.
5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

J. No more than three branch circuits shall be installed in any one conduit.

K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES

A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

B. Fireproofing:

1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
2. Use fireproofing tape as specified in Section 26 05 13, MEDIUM-VOLTAGE CABLES, and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3.3 SPLICE AND TERMINATION INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure and tightened to manufacturer's published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.4 CONDUCTOR IDENTIFICATION

A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pull boxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 FEEDER CONDUCTOR IDENTIFICATION

A. In each interior pull box and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.6 EXISTING CONDUCTORS

A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.7 CONTROL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.9 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests: Inspect physical condition.
2. Electrical tests:
   a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
   b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
   c. Perform phase rotation test on all three-phase circuits.

---END---

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.

B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

D. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.

E. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
2. Test Reports:

a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COTR.

3. Certifications:

a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Society for Testing and Materials (ASTM):

B1-13 ..... Standard Specification for Hard-Drawn Copper Wire

B3-13 ..... Standard Specification for Soft or Annealed Copper Wire

B8-11 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-12 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

70E-15 ..... National Electrical Safety Code

99-15 ..... Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-14 ..... Thermoset-Insulated Wires and Cables

83-14 ..... Thermoplastic-Insulated Wires and Cables

467-13 ..... Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.

B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE

A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7 GROUNDING BUS BAR

A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.

2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:

1. Connect the equipment grounding conductors to the ground bus.
2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

D. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.

3.4 RACEWAY

A. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

C. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Wireway Systems:

1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).

E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

H. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.

I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.5 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT

A. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

B. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods and extend underground to the

immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.6 CORROSION INHIBITORS

A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.8 LIGHTNING PROTECTION SYSTEM

A. Bond the lightning protection system to the electrical grounding electrode system.

3.9 MAIN ELECTRICAL ROOM GROUNDING

A. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.

3.10 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.11 GROUND ROD INSTALLATION

A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.

B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.

C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.

D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.12 ACCEPTANCE CHECKS AND TESTS

A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END---

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.

B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

C. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

D. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.

E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Conduits bracing.

F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

H. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Size and location of main feeders.
   b. Size and location of panels and pull-boxes.

c. Layout of required conduit penetrations through structural elements.

d. Submit the following data for approval:

1) Raceway types and sizes.

2) Conduit bodies, connectors, and fittings.

3) Junction and pull boxes, types, and sizes.

2. Certifications: Two weeks prior to final inspection, submit the following:

a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.

b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Iron and Steel Institute (AISI):

S100-12 ..... North American Specification for the Design of Cold-Formed Steel Structural Members

C. National Electrical Manufacturers Association (NEMA):

C80.1-15 ..... Electrical Rigid Steel Conduit

C80.3-15 ..... Steel Electrical Metal Tubing

C80.6-05 ..... Electrical Intermediate Metal Conduit

FB1-14 ..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

FB2.10-13 ..... Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)

FB2.20-14 ..... Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

TC-2-13 ..... Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

TC-3-13 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing

D. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

1-05 .....Flexible Metal Conduit

5-16 .....Surface Metal Raceway and Fittings

6-07 .....Electrical Rigid Metal Conduit - Steel

50-15 .....Enclosures for Electrical Equipment

360-13 .....Liquid-Tight Flexible Steel Conduit

467-13 .....Grounding and Bonding Equipment

514A-13.....Metallic Outlet Boxes

514B-12.....Conduit, Tubing, and Cable Fittings

514C-14.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-11 .....Schedule 40 and 80 Rigid PVC Conduit and Fittings

651A-11.....Type EB and A Rigid PVC Conduit and HDPE Conduit

797-07 .....Electrical Metallic Tubing

1242-14 .....Electrical Intermediate Metal Conduit - Steel

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than ¾-inch unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recess lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than ¾-inch.
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and NEMA C80.6.
4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
5. Flexible Metal Conduit: Shall conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).
8. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:
    a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
    b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
    c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
    d. Bushings: Metallic insulating type, consisting of an insulating insert, molded, or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
    e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
    f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Electrical Metallic Tubing Fittings:
    a. Fittings and conduit bodies shall meet the requirements of UL 514B, NEMA C80.3, and NEMA FB1.
    b. Only steel or malleable iron materials are acceptable.
    c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
    d. Indent-type connectors or couplings are prohibited.
    e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
    a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
    b. Clamp-type, with insulated throat.
5. Liquid-tight Flexible Metal Conduit Fittings:
    a. Fittings shall meet the requirements of UL 514B and NEMA FB1.

b. Only steel or malleable iron materials are acceptable.

c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.

7. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.

8. Expansion and Deflection Couplings:

a. Conform to UL 467 and UL 514B.

b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.

c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.

d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:

1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.

4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. Comply with UL-50 and UL-514A.

2. Rustproof cast metal where required by the NEC or shown on drawings.

3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
   1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
   2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR where working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

A. In accordance with NEC, NEMA, UL, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:
   1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
   2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
   3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
   4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
   5. Cut conduits square, ream, remove burrs, and draw up tight.
   6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.

7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.
11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
13. Conduit bodies shall only be used for changes in direction and shall not contain splices.

D. Conduit Bends:
1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only:
   a. Where shown on the structural drawings.
   b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.

b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.

c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.

5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the same system is prohibited.
2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.

B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.

C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.

D. Align and run conduit parallel or perpendicular to the building lines.

E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.

G. Surface Metal Raceways: Use only where shown on drawings.

H. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.

2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 DIRECT BURIAL INSTALLATION

A. Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only.

B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.7 WET OR DAMP LOCATIONS

A. Use rigid steel or IMC conduits unless as shown on drawings.

B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer, and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.8 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.9 EXPANSION JOINTS

A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

3.10 CONDUIT SUPPORTS

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.

b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).

c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush-mounted.

2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4–90-degree bends are necessary.

C. Locate pull boxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of underground ducts and raceways, and precast manholes and pull boxes to form a complete underground electrical raceway system.

B. The terms “duct” and “conduit” are used interchangeably in this section.

1.2 RELATED WORK

A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 31 20 11, EARTH WORK (SHORT FORM): Trenching, backfill, and compaction.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Coordinate layout and installation of ducts, manholes, and pull boxes with final arrangement of other utilities, site grading, and surface features.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

   a. Submit sufficient information to demonstrate compliance with drawings and specifications.

   b. Submit information on manholes, pull boxes, ducts, and hardware. Submit manhole plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.

   c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pull boxes, or duct banks at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the COR for approval prior to construction.

2. Certifications: Two weeks prior to the final inspection, submit the following.
   a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Concrete Institute (ACI):

Building Code Requirements for Structural Concrete

318-14/318M-14.....Building Code Requirements for Structural Concrete & Commentary

SP-66-04.....ACI Detailing Manual

C. American National Standards Institute (ANSI):

77-14.....Underground Enclosure Integrity

D. American Society for Testing and Materials (ASTM):

C478 REV A-15.....Standard Specification for Precast Reinforced Concrete Manhole Sections

C858-10.....Underground Precast Concrete Utility Structures

C990-09.....Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

E. National Electrical Manufacturers Association (NEMA):

TC 2-13.....Electrical Polyvinyl Chloride (PVC) Conduit

TC 3-15.....Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

TC 6 & 8-13.....Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

TC 9-04.....Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

F. National Fire Protection Association (NFPA):

70-17.....National Electrical Code (NEC)

70E-15.....National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

6-07.....Electrical Rigid Metal Conduit-Steel

467-13.....Grounding and Bonding Equipment

651-11.....Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

651A-11.....Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

PART 2 - PRODUCTS

2.1 PRE-CAST CONCRETE MANHOLES AND HARDWARE

A. Structure: Factory-fabricated, reinforced-concrete, monolithically- poured walls and bottom. Frame and cover shall form top of manhole.

B. Minimum sized for 10 (ten) 4” (four inch) conduits serving the Main Computer Room (Data Center) and minimum sized to serve 4 (four) 4” (four inch) conduits in all non-Main Computer Room locations.

C. All vaults shall be traffic rated to 20,000 pounds.

D. Cable Supports:

1. Cable stanchions shall be hot-rolled, heavy duty, hot-dipped galvanized "T" section steel, 56 mm (2.25 inches) x 6 mm (0.25 inch) in size and punched with 14 holes on 38 mm (1.5 inches) centers for attaching cable arms.
2. Cable arms shall be 5 mm (0.1875 inch) gauge, hot-rolled, hot-dipped galvanized sheet steel, pressed to channel shape. Arms shall be approximately 63 mm (2.5 inches) wide x 350 mm (14 inches) long.
3. Insulators for cable supports shall be porcelain and shall be saddle type or type that completely encircles the cable.
4. Equip each cable stanchion with one spare cable arm, with three spare insulators for future use.

E. Ladder: Provide as required.

F. Ground Rod Sleeve: Provide a 75 mm (3 inches) PVC sleeve in manhole floors so that a driven ground rod may be installed.

G. Sump: Provide 305 mm x 305 mm (12 inches x 12 inches) covered sump frame, sump, and grated cover.

2.2 PULLBOXES

A. General: Size as indicated on the drawings.

1. Refer to Drawing C-500, Exterior Handhole Box Details.

2. Acceptable Manufacturer Hubbell Quazite or approved equal
    a. Large hand hole part number PG3048B280
    b. Smaller hand hole part number PG2436B127

B. Provide pull boxes with weatherproof, non-skid covers with UNC self-aligning, replicable S.S. EX-Nut; 2 places.

C. Cover material shall be identical to pull box material. Covers shall have molded lettering OPTICAL FIBER or COMMUNICATIONS. Pull boxes shall comply with the requirements of ANSI 77 Tier 22 loading.

D. Polymer Concrete Pull boxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pull box shall have open bottom.

E. Cable supports: metal cable rack struts.

F. Duct terminators: Minimum of 9 (nine) at the Main Computer Room and minimum of 5 (five) at other vault locations, 4”, per drawings.

2.3 DUCTS

A. Number and sizes shall be as shown on the drawings and schedules.

B. Ducts (concrete-encased):
    1. Plastic Duct:
        a. UL 651 Schedule 40 PVC conduit.
        b. Duct shall be suitable for use with 90˚ C (194˚ F) rated conductors.
    2. Conduit Spacers: Prefabricated plastic.
    3. Rigid metal conduit: UL 6 and NEMA RN1 galvanized rigid metal, half- lap wrapped with 10 mil PVC tape from last PHH to building entry.

2.4 CONDUIT TO BUILDING PENETRATION

A. From last hand hole serving building, provide a minimum 40” factory long sweep galvanized rigid metal, four (4) inch conduit, quantity per schedule.

B. Provide NEMA-4 rated aluminum enclosure mounted onto Unistrut attached to building.

C. Provide minimum 40” factory long sweeps for all entries as follows:
    1. Per drawings
    2. -OR-
        a. For two-tube cables, 2” diameter
        b. For four to seven-tube cables, 3” diameter
        c. For twelve to nineteen-tune cables, 4” diameter

D. Building penetration through contractor core drilled hole, provide modular type wall penetration seal and resilient waterproof calking, per drawings.

2.5 GROUNDING

A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.6 WARNING TAPE

A. 4-mil polyethylene 75 mm (3 inches) wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED FIBER OPTIC CABLE BELOW" or similar, installed per drawings.

2.7 PULL ROPE FOR SPARE DUCTS

A. Plastic with 890 N (200 lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 MANHOLE AND PULLBOX INSTALLATION

A. Assembly and installation shall be per the requirements of the manufacturer.
   1. Install manholes and pull boxes level and plumb.
   2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.

B. Use large hand hole with four (4) conduit terminators when four conduits are specified. Use smaller hand hole with three (3) conduits for all else. Refer to communications drawing details.

C. Access: Ensure the top of frames and covers are flush with finished grade.

3.2 TRENCHING

A. Refer to Section 31 20 00 EARTH WORK for trenching, backfilling, and compaction.

B. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.

C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.

D. Cut the trenches neatly and uniformly.

E. For Concrete-Encased Ducts:
   1. Concrete encasement is required for all fiber-optic and medium-voltage cabling, unless specifically noted on the drawings. Refer to drawings for additional information.
   2. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1.2 M (4

feet) intervals to establish the grade and route of the duct bank.

3. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
4. The walls of the trench may be used to form the side walls of the duct bank, provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.

F. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the COR.

3.3 DUCT INSTALLATION

A. General Requirements:

1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Join and terminate ducts with fittings recommended by the manufacturer.
3. Slope ducts to drain towards pull boxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape and shall extend a minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide

nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.

9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water.
10. Clearances between individual ducts:
    a. For similar services, not less than 75 mm (3 inches).
    b. For power and signal services, not less than 150 mm (6 inches).
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. Concrete-Encased Ducts:
    1. Install concrete-encased ducts for medium-voltage systems, low- voltage systems, and signal systems per drawings.
        a. Concrete encasement is only required where the new Side-A and new Side-B cross each other or crosses the existing underground fiber pathways.
    2. Duct banks shall be single or multiple duct assemblies encased in concrete. Ducts shall be uniform in size and material throughout the installation.
    3. Tops of concrete-encased ducts shall be:
        a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below

finished grade.

b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.

c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.

d. Conduits crossing under grade slab construction joints shall be installed a minimum of 1.2 M (4 feet) below slab.

4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 inches) beyond the outside walls of the outer ducts.

5. Within 3 M (10 feet} manhole wall penetrations, install reinforcing steel bars at the top and bottom of each concrete envelope to provide protection against vertical shearing.

6. Install reinforcing steel bars at the top and bottom of each concrete envelope of all duct's underneath roadways and parking areas.

7. Where new ducts and concrete envelopes are to be joined to existing manholes, pull boxes, ducts, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.

8. Duct joints in concrete may be placed side by side horizontally but shall be staggered at least 150 mm (6 inches) vertically.

9. Pour each run of concrete envelope between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in a vertical plane and install 19 mm (0.75 inch) reinforcing rod dowels extending 450 mm (18 inches) into concrete on both sides of joint near corners of envelope.

10. Pour concrete so that open spaces are uniformly filled. Do not agitate with power equipment unless approved by COR.

C. Partially Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

A. Duct Testing and Cleaning:

1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions. The mandrel shall be not less than 300 mm (12 inches) long and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
2. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the COR.
3. Mandrel pulls shall be witnessed by the COR.

---END---

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.

B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.

C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. The study shall be prepared by the equipment manufacturer and performed by the equipment manufacturer's licensed electrical engineer.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronics Engineers (IEEE):

241-90 ..... Recommended Practice Electrical Systems in Commercial Buildings

242-03 ..... Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

399-97 ..... Recommended Practice for Industrial and Commercial Power Systems Analysis

1584-02 ..... Performing Arc-Flash Hazards Calculations

1584A-04 ..... Performing Arc-Flash Hazards Calculations – Amendment 1

1584B-11 ..... Performing Arc-Flash Hazards Calculations – Amendment 2

C. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

70E-18 ..... Standard for Electrical Safety in the Workplace

99-18 ..... Health Care Facilities Code

1.6 STUDY REQUIREMENTS

A. The study shall be in accordance with IEEE and NFPA standards.

B. The study shall include one line diagram, short-circuit and ground fault analysis, protective coordination plots for all overcurrent protective devices, and arc flash calculations and analysis.

C. One Line Diagram:

1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
2. Show the following specific information:
   a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
   b. Relay, circuit breaker, and fuse ratings.
   c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
   d. Voltage at each bus.
   e. Identification of each bus, matching the identification on the drawings.

f. Conduit, conductor, and busway material, size, length, and X/R ratios.

D. Short-Circuit Study:

1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
3. Present the results of the short-circuit study in a table. Include the following:
   a. Device identification.
   b. Operating voltage.
   c. Overcurrent protective device type and rating.
   d. Calculated short-circuit current.

E. Coordination Study:

1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
2. The following specific information shall also be shown on the coordination curves:
   a. Device identification.
   b. Potential transformer and current transformer ratios.
   c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
   d. Applicable circuit breaker or protective relay characteristic curves.
   e. No-damage, melting, and clearing curves for fuses.
   f. Transformer in-rush points.
3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
   a. Device identification.

b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.

c. Fuse rating and type.

F. Arc Flash Calculations and Analysis:

1. Arc flash warning labels shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
2. Arc flash calculations shall be based on actual over-current protective device clearing time. Maximum clearing time shall be in accordance with IEEE 1584.
3. Arc flash analysis shall be based on the lowest clearing time setting of the over-current protective device to minimize the incident energy level without compromising selective coordination.
4. Arc flash boundary and available arc flash incident energy at the corresponding working distance shall be calculated for all electrical power distribution equipment specified in the project, and as shown on the drawings.
5. Required arc-rated clothing and other PPE shall be selected and specified in accordance with NFPA 70E.

1.7 ANALYSIS

A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS

A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems, and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to

SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the lighting controls.

1.2 RELATED WORK

A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

E. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.

F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

G. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

    a. Submit the following information for each type of lighting controls.

    b. Material and construction details.

    c. Physical dimensions and description.

    d. Wiring schematic and connection diagram.

    e. Installation details.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturer's Association (NEMA):

C136.10-10 ..... American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

ICS-1-15 ..... Standard for Industrial Control and Systems General Requirements

ICS-2-05 ..... Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment

ICS-6-16 ..... Standard for Industrial Controls and Systems Enclosures

C. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

20-10 ..... Standard for General-Use Snap Switches

98-16 ..... Enclosed and Dead-Front Switches

773-16 ..... Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A-16.....Nonindustrial Photoelectric Switches for Lighting Control

916-15 .....Standard for Energy Management Equipment Systems

917-06 .....Clock Operated Switches

924-16 .....Emergency Lighting and Power Equipment (for use when controlling emergency circuits).

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1-to-15-minute adjustable time delay for turning lights off.
   2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volts and 277 volts, for 13A tungsten at 120 volts, and for 1 hp at 120 volts.
   4. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   6. Bypass Switch: Override the on function in case of sensor failure.
   7. Manual/automatic selector switch.
   8. Automatic Light-Level Sensor: Adjustable from 21.5 to 2152 lx (2 to 200 fc); keep lighting off when selected lighting level is present.
   9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in) and

detect a person of average size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).

C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, as shown on the drawings, and as specified.

B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle turn-on.

C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.

D. Set occupancy sensor "on" duration to 15 minutes.

E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.

F. Label time switches and contactors with a unique designation.

G. Program lighting control panels per schedule on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations.

B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.

D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of COR.

3.4 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 8-hour training period for instructing personnel in the maintenance and operation of the lighting control system on the dates requested by the COR.

B. Contractor shall submit written instructions on training and maintenance as reviewed in training session.

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SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

   a. Submit sufficient information to demonstrate compliance with drawings and specifications.

   b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

   c. Certification from the manufacturer that representative transformers have been seismically tested to International Building Code requirements. Certification shall be

based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the transformers.
      2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the transformers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
   IBC-15 ..... International Building Code

C. National Fire Protection Association (NFPA):
   70-17 ..... National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):
   TR 1-13 ..... Transformers, Step Voltage Regulators and Reactors
   ST 20-14 ..... Dry Type Transformers for General Applications

E. Underwriters Laboratories, Inc. (UL):
   UL 506-17 ..... Standard for Specialty Transformers
   UL 1561-11 ..... Dry-Type General Purpose and Power Transformers

F. United States Department of Energy:

10 CFR Part 431.....Energy Efficiency Program for Certain Commercial and Industrial Equipment

PART 2 - PRODUCTS

2.1 TRANSFORMERS

A. Unless otherwise specified, transformers shall be in accordance with NEMA, NFPA, UL and as shown on the drawings.

B. Transformers shall have the following features:

1. Self-cooled by natural convection, isolating windings, indoor and outdoor dry type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
2. Rating and winding connections shall be as shown on the drawings.
3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
4. Copper windings.
5. Insulation systems:
   a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
   b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
6. Core and coil assemblies:
   a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
   b. Cores shall be grain-oriented, non-aging, and silicon steel.
   c. Coils shall be continuous windings without splices except for taps.
   d. Coil loss and core loss shall be minimized for efficient operation.
   e. Primary and secondary tap connections shall be brazed or pressure type.
   f. Coil windings shall have end filters or tie-downs for maximum strength.
7. Average audible sound levels shall comply with NEMA.
8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two

2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.

10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
    a. Comprised of not less than code gauge steel.
    b. Outdoor enclosures shall be NEMA 3R.
    c. Temperature rise at hottest spot shall conform to NEMA Standards and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
    d. Ventilation openings shall prevent accidental access to live components.
    e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy's 10 CFR Part 431.

2.2 NONLINEAR TRANSFORMERS

A. Nonlinear transformers shall be as specified in Paragraph 2.1, with additional features as specified below.
B. Transformers shall be designed to withstand the overheating effects caused by harmonics resulting from non-linear (non-sinusoidal) loads.
C. Neutral rating shall be 200% of rated secondary phase current.
D. Transformers with K factor of 13 shall be provided, if K factor is not shown on contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.
B. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer's instructions, and as shown on drawings.
C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Exterior Location: Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turn-ups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

E. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).

F. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical and mechanical condition.
   c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
   d. Perform specific inspections and mechanical tests as recommended by manufacturer.
   e. Verify correct equipment grounding.
   f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

---END---

SECTION 26 23 00
LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of low-voltage switchgear circuit breakers. The scope of this specification addresses the modification of existing switchgear to add/remove low-voltage switchgear circuit breakers. Reference drawings for additional information.

1.2 RELATED WORK

D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

G. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

H. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

C. Switchgear shall be tested, with the circuit breakers in the connected position in their compartments. Tests shall be in accordance with IEEE C37.20.1 and NEMA C37.51. Factory tests shall be certified, and shall include the following tests:

1. Design tests.
2. Production tests.
3. Conformance tests.

D. The following additional tests shall be performed:

1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
4. Verify correct barrier and shutter installation and operation.
5. Exercise all active components.
6. Inspect indicating devices for correct operation.
7. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
8. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
9. If applicable, verify correct function of control transfer relays located in the switchgear with multiple control power sources.
10. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.

1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
   1. Shop Drawings:
      a. Switchgear shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
      b. Submit sufficient information to demonstrate compliance with drawings and specifications.
      c. Prior to fabrication of switchgear, submit the following data for approval:
         1) Complete electrical ratings.
         2) Circuit breaker sizes.
         3) Interrupting ratings.
         4) Safety features.
         5) Accessories and nameplate data.

6) Switchgear one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
7) Elementary and interconnection wiring diagrams.
8) Technical data for each component.
9) Dimensioned exterior views of the switchgear.
10) Dimensioned section views of the switchgear.
11) Floor plan of the switchgear.
12) Foundation plan for the switchgear.
13) Provisions and required locations for external conduit and wiring entrances.
14) Approximate design weights.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchgear.
      2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that switchgear conforms to the requirements of the drawings and specifications.
   b. Certification by the Contractor that switchgear has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

C37.13-15 ..... Low-voltage AC Power Circuit Breakers Used in Enclosures

C37.20.1-15 ..... Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

C57.13-16 ..... Instrument Transformers

C62.41.1-08 ..... Surge Environment in Low-voltage (1000V or less) AC Power Circuits

C62.45-08 ..... Surge Testing for Equipment connected to Low-Voltage AC Power Circuits

C. International Code Council (ICC):

IBC-21 ..... International Building Code

D. National Electrical Manufacturers Association (NEMA):

C37.51-18 ..... Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies — Conformance Test Procedures

C37.51A-10 ..... Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies — Conformance Test Procedures Amendment 1 Short-Time Withstand Current Tests

E. National Fire Protection Association (NFPA):

70-23 ..... National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL):

891-19 ..... Switchboards

977-12 ..... Safety Fused Power-Circuit Devices

1053-15 ..... Ground Fault Sensing and Relaying Equipment

1558-16 ..... Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

PART 2 - PRODUCTS

2.1 LOW-VOLTAGE POWER CIRCUIT BREAKERS

A. General: Shall be in accordance with IEEE, NEMA, NFPA, UL. Circuit breakers shall be dead front, drawout, stored energy type with solid state trip devices. Arcing contacts shall be renewable.

B. Rating: Circuit breakers shall be 3 pole, 600 volts AC and below, 60 cycle with frame size, trip rating and functions, and system voltage as shown on drawings. Breakers shall have 30 cycle short time current ratings.

C. Drawout Mounting: Provide a racking mechanism to position and hold the breaker in the connected, test, or disconnected position. Provide an interlock to prevent movement of the breaker into or out of the connected position unless the breaker is tripped open.

D. Trip Devices: Breakers shall be electrically and mechanically trip free and shall have trip devices in each pole. Unless otherwise indicated on drawings, each breaker shall have overcurrent and short-circuit trip devices. Trip devices shall be of the solid state type with adjustable pick-up settings, with both long time and short time elements, and integral trip unit testing provisions. Devices shall have time-delay band adjustment. Long-time delay element shall have inverse time characteristics. Main circuit breakers shall not have instantaneous trip function.

E. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.

F. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door.

G. Padlocking: Provisions shall be included for padlocking the breaker in the open position.

H. Operation: Unless otherwise indicated herein or on the drawings, breakers 1600 ampere frame size and less shall be manually operated. Breakers larger than 1600 ampere frame size shall be electrically operated.

I. Retro-fit circuit breakers shall be complete replacements. Provide all equipment, connections, and appurtenances required for a complete and fully functional syste,. Coordinate with equipment manufacturer as required.

2.2 OTHER EQUIPMENT

A. Furnish tools and accessories required for circuit breaker and switchgear test, inspection, maintenance, and proper operation.

2.3 CONTROL WIRING

A. Switchgear control wires shall not be less than No. 14 AWG copper 600 V rated. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.4 NAMEPLATES AND MIMIC BUS

A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

C. In seismic areas, switchgear shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Confirm correct application of manufacturer's recommended lubricants.
   d. Verify appropriate anchorage, required area clearances, and correct alignment.
   e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
   f. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
   g. Confirm correct operation and sequencing of key-type mechanical interlock systems.
   h. Vacuum-clean switchgear enclosure interior. Clean switchgear enclosure exterior.
   i. Inspect insulators for evidence of physical damage or contaminated surfaces.

j. Verify correct shutter installation and operation.

k. Exercise all active components.

l. Verify the correct operation of all sensing devices, alarms, and indicating devices.

m. Verify that vents are clear.

2. Electrical tests:

a. Perform insulation-resistance tests on each bus section.

b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.

c. Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchgear is in good operating condition and properly performing the intended function.

3.4 TEMPORARY HEATING

A. Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.6 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.

B. Furnish a written sequence of operation for the switchgear and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.

C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.7 AS-LEFT TRIP UNIT SETTINGS

A. The trip unit settings shall be set in the field by an authorized representative of the switchgear manufacturer per the approved Overcurrent Protective Device Coordination Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.

C. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchgear room. Deliver four additional copies of the settings to the COR prior to the activation of the switchgear.

3.8 INSTRUCTION

A. Furnish the services of a factory-trained technician for two, 4-hour training periods for instructing personnel in the maintenance and operation of the switchgear, on the dates requested by the COR.

---END---

SECTION 26 24 13
DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the low-voltage circuit-breaker distribution switchboards, indicated as switchboard(s) in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint for nonstructural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

H. Section 26 25 11, BUSWAYS: Feeder busway and fittings.

I. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices for switchboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:

1. Tests shall be conducted per NEMA PB 2.
2. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.

3. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
5. Exercise all active components.
6. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
7. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
8. If applicable, verify correct function of control transfer relays located in the switchboard with multiple control power sources.
9. Perform phasing checks on double-ended or dual-source switchboards to insure correct bus phasing from each source.

1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Switchboard shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
   b. Submit sufficient information to demonstrate compliance with drawings and specifications.
   c. Prior to fabrication of switchboards, submit the following data for approval:
      1) Complete electrical ratings.
      2) Circuit breaker sizes.
      3) Interrupting ratings.
      4) Safety features.
      5) Accessories and nameplate data.
      6) Switchboard one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
      7) Elementary and interconnection wiring diagrams.
      8) Technical data for each component.

9) Dimensioned exterior views of the switchboard.
10) Dimensioned section views of the switchboard.
11) Floor plan of the switchboard.
12) Foundation plan for the switchboard.
13) Provisions and required locations for external conduit and wiring entrances.
14) Approximate design weights.

d. Certification from the manufacturer that representative switchboards have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchboard.
      2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the switchboards conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the switchboards have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

C37.13-15 ..... Low Voltage AC Power Circuit Breakers Used in Enclosures

C57.13-16 ..... Instrument Transformers

C62.41.1-08 ..... Surge Environment in Low-voltage (1000V and less) AC Power Circuits

C62.45-08 ..... Surge Testing for Equipment connected to Low-Voltage AC Power Circuits

C. International Code Council (ICC):

IBC-21 ..... International Building Code

D. National Electrical Manufacturer's Association (NEMA):

PB 2-11 ..... Deadfront Distribution Switchboards

PB 2.1-13 ..... Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

E. National Fire Protection Association (NFPA):

70-23 ..... National Electrical Code (NEC)

F. Underwriters Laboratories, Inc. (UL):

67-18 ..... Panelboards

489-16 ..... Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

891-19 ..... Switchboards

PART 2 - PRODUCTS

2.1 GENERAL

A. Shall be in accordance with IEEE, NEMA, NFPA, UL, as shown on the drawings, and have the following features:

1. Switchboard shall be a complete, grounded, continuous-duty, integral assembly, dead-front, dead-rear, self-supporting, indoor type switchboard assembly. Incorporate devices shown

on the drawings and all related components required to fulfill operational and functional requirements.

2. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than the available fault current shown in the Overcurrent Protective Device Coordination Study.
3. Switchboard shall conform to the arrangements and details shown on the drawings.
5. Key-type mechanical interlocks for multiple circuit breakers shall be provided as shown on the drawings.
6. Switchboards shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Packaging shall provide adequate protection against rough handling during shipment.
7. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.
8. Series rated switchboards are not allowed.

2.2 BASIC ARRANGEMENT

A. Type 1: Switchboard shall be front accessible with the following features:
   1. Device mounting:
      a. Main breaker: Individually mounted and compartmented or group mounted with feeder breakers.
      b. Feeder breakers: Group mounted.
   2. Section alignment: As shown on the drawings.
   3. Accessibility:
      a. Main section line and load terminals: Front and side.
      b. Distribution section line and load terminals: Front.
      c. Through bus connections: Front and end.
   4. Bolted line and load connections.
   5. Full height wiring gutter covers for access to wiring terminals.

2.3 HOUSING

A. Shall have the following features:
   1. Frames and enclosures:

a. The assembly shall be braced with reinforcing gussets using bolted connections to assure rectangular rigidity.
b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
c. Die-pierce the holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
d. All bolts, nuts, and washers shall be zinc-plated steel.

B. Finish:
1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
2. Provide a light gray finish for indoor switchboard.
3. Outdoor switchboard:
a. Interior finish shall be light gray.
b. Exterior finishes shall be as specified in the Section 09 06 00, SCHEDULE FOR FINISHES.
c. The underside of the switchboard shall be treated with corrosion resistant compounds, epoxy resin or rubberized sealing compound.

2.4 BUSES

A. Bus Bars and Interconnections:
1. Provide copper phase and neutral buses, fully rated for the amperage as shown on the drawings for the entire length of the switchboard. Bus laminations shall have a minimum of 6 mm (1/4 inch) spacing.
2. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
3. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
4. Install a copper ground bus the full length of the switchboard assembly.
5. Main Bonding Jumper: An un-insulated copper bus, size as shown on drawings, shall interconnect the neutral and ground buses, when the switchboard is used to establish the system common ground point.
6. All bolts, nuts, and washers shall be zinc-platedsteel. Bolts shall be torqued to the values recommended by the manufacturer.

7. Make provisions for future bus extensions by means of bolt holes or other approved method.

2.5 MAIN CIRCUIT BREAKERS

A. Type I or Type II Switchboards: Provide molded case main circuit breakers as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.
   1. Trip units shall have field adjustable tripping characteristics as follows:
      a. Long time pickup.
      b. Long time delay.
      c. Short time pickup.
      d. Short time delay.
      e. Instantaneous.
      f. Ground fault pickup.
      g. Ground fault delay.
   2. Breakers with same frame size shall be interchangeable with each other.
   3. Breakers shall be fully rated, where indicated on drawings.

2.3 FEEDER CIRCUIT BREAKERS

A. Provide molded case circuit breakers as shown on the drawings.
B. Non-adjustable Trip Molded Case Circuit Breakers:
   1. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time characteristics, and instantaneous magnetic trip.
   2. Breaker features shall be as follows:
      a. A rugged, integral housing of molded insulating material.
      b. Silver alloy contacts.
      c. Arc quenchers and phase barriers for each pole.
      d. Quick-make, quick-break, operating mechanisms.
      e. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
      f. Electrically and mechanically trip free.
      g. An operating handle which indicates ON, TRIPPED, and OFF positions.
      h. Line and load connections shall be bolted.

i. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

C. Adjustable Trip Molded Case Circuit Breakers:

1. Provide molded case, solid state adjustable trip type circuit breakers.
2. Trip units shall have field adjustable tripping characteristics as follows:
   a. Long time pickup.
   b. Long time delay.
   c. Short time pickup.
   d. Short time delay.
   e. Instantaneous.
   f. Ground fault pickup.
   g. Ground fault delay.
3. Breakers with same frame size shall be interchangeable with each other.

2.8 SURGE PROTECTIVE DEVICES

A. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

2.9 DIGITAL POWER METERS (DPM)

A. All switchboards shall include DPMs; see drawings on if they are integral or external. Provide all connections, raceways, OCPDs, and conductors required for installation.

B. ELECTRICAL METER APPLICATIONS

1. The RS-485 communications shall provide communications links up to 10,000 feet long.
2. Power meters shall be installed as part of the advanced utility metering system and as indicated in Panelboard specification “26 24 16”.
   a. All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
   b. The power meter may be applied in three-phase, three- or four- wire systems.
   c. The power meter shall be capable of being applied without modification at nominal frequencies of 50, 60, or 400 Hz.
   d. The power meter shall provide for onboard data logging, able to log data, alarms, waveforms, and events.

B. Physical and Common Requirements

1. Electrical power meters shall be separately mounted, and enclosed in a NEMA 250, Type 1 enclosure, unless where indicated on the plans to be internal to the power distribution

equipment it is monitoring. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

a. Ambient conditions of 0 to 140 deg F dry bulb and 20 to 95 percent relative humidity, noncondensing.

C. Current and voltage ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Voltage inputs from standard instrument potential transformers with 120-volt secondary output. The power meter shall support PT primaries through 3.2 MV.
4. The power meter shall operate properly over a wide range of control power including 90-457 VAC or 100-300 VDC.

D. Electrical measurements and calculated values

1. Power meters shall include the following rms Real-Time Measurements:
   a. Current: Each phase, neutral, average of three phases, percent unbalance.
   b. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
   c. Power: Per phase and three-phase total.
   d. Reactive Power: Per phase and three-phase total.
   e. Apparent Power: Per phase and three-phase total.
   f. True Power Factor: Per phase and three-phase total.
   g. Displacement Power Factor: Per phase and three-phase total.
   h. Frequency.
   i. THD: Current and voltage.
   j. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
   k. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
   l. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
2. Power meters shall perform the following demand current calculations, per phase, three-phase average and neutral:

a. Present.
b. Running average.
c. Last completed interval.
d. Peak.

3. Power meters shall perform the following demand real power calculations, three-phase total:
   a. Present.
   b. Running average.
   c. Last completed interval.
   d. Predicted.
   e. Peak.
   f. Coincident with peak kVA demand.
   g. Coincident with kVAR demand.
4. Power meters shall perform the following demand reactive power calculations, three-phase total:
   a. Present.
   b. Running average.
   c. Last completed interval.
   d. Predicted.
   e. Peak.
   f. Coincident with peak kVA demand.
   g. Coincident with kVAR demand.
5. Power meters shall perform the following demand apparent power calculations, three-phase total:
   a. Present.
   b. Running average.
   c. Last completed interval.
   d. Predicted.
   e. Peak.
   f. Coincident with peak kVA demand.
   g. Coincident with kVAR demand.

6. Power meters shall perform the following average true power factor calculations, demand coincident, three-phase total:
   a. Last completed interval.
   b. Coincident with kW peak.
   c. Coincident with kVAR peak.
   d. Coincident with kVA peak.
7. Power Analysis Values:
   a. THD, Voltage and Current: Per phase, three phase, and neutral.
   b. Displacement Power Factor: Per phase, three phase.
   c. Fundamental Voltage, Magnitude and Angle: Per phase.
   d. Fundamental Currents, Magnitude and Angle: Per phase.
   e. Fundamental Real Power: Per phase, three phase.
   f. Fundamental Reactive Power: Per phase.
   g. Harmonic Power: Per phase, three phase.
   h. Phase rotation.
   i Unbalance: Current and voltage.
   j. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.
8. Power meters shall perform one of the following demand calculations, selectable by the User; meters shall be capable of performance of all of the following demand calculations.
   a. Block interval with optional subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
      1) Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
      2) Fixed block that calculates demand at end of the interval.
      3) Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
   c. Minimum and maximum values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
      1) Line-to-line voltage.
      2) Line-to-neutral voltage.

3) Current per phase.
4) Line-to-line voltage unbalance.
5) Line-to-neutral voltage unbalance.
6) Power factor.
7) Displacement power factor.
8) Total power.
9) Total reactive power.
10) Total apparent power.
11) THD voltage L-L.
12) THD voltage L-N.
13) THD current.
14) Frequency.

d. Harmonic calculation: display and record the following:
1) Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2) Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by the VA.

F. Meter accuracy:
1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
2. Accuracy from Light to Full Rating:
a. Power: Accurate to 0.5 percent of reading.
b. Voltage and Current: Accurate to 0.5 percent of reading.
c. Power Factor: Plus or minus 0.005, from 0.5 leading to 0.5 lagging.
d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

G. Meter input, sampling, display, output, recording and reading Capabilities
1. Input: One digital input signal.
a. Normal mode for on/off signal.
b. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
c. Conditional energy signal to control conditional energy accumulation.

d. GPS time synchronization.

2. Sampling:
   a. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
   b. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.
3. Display Monitor:
   a. Backlighted LCD to display metered data with touchscreen or touchpad selecting device.
   b. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
   c. Display four values on one screen at same time.
      1) Coordinate list below with meter capabilities specified in subparagraphs above.
      2) Current, per phase rms, three-phase average and neutral.
      3) Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
      4) Real power, per phase and three-phase total.
      5) Reactive power, per phase and three-phase total.
      6) Apparent power, per phase and three-phase total.
      7) Power factor, per phase and three-phase total.
      8) Frequency.
      9) Demand current, per phase and three-phase average.
      10) Demand real power, three-phase total.
      11) Demand apparent power, three-phase total.
      12) Accumulated energy (MWh and MVARh).
      13) THD, current and voltage, per phase.
   d. Reset: Allow reset of the following parameters at the display:
      1) Peak demand current.
      2) Peak demand power (kW) and peak demand apparent power (kVA).
      3) Energy (MWh) and reactive energy (MVARh).
4. Outputs:
   a. Operated either by user command sent via communication link or set to operate in response to user-defined alarm or event.

b. Closed in either a momentary or latched mode as defined by user.

c. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.

d. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.

e. One relay output module, providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.

f. Output Relay Control:

1) Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.

2) Normally open and normally closed contacts, field configured to operate as follows:

a) Normal contact closure where contacts change state for as long as signal exists.

b) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.

c) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.

d) End of power demand interval when relay operates as synchronization pulse for other devices.

e) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.

f) Output controlled by multiple alarms using Boolean-type logic.

5. Onboard Data Logging:

a. Store logged data, alarms, events, and waveforms in 2 MB of onboard nonvolatile memory.

b. Stored Data:

1) Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.

2) Custom Data Logs: three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:

a) Schedule interval.

b) Event definition.

c) Configured as "fill-and-hold" or "circular, first-in first-out."

3) Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.

4) Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

c. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

6. Alarms.

a. User Options:

1) Define pickup, dropout, and delay.

2) Assign one of four severity levels to make it easier for user to respond to the most important events first.

3) Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.

b. Alarm Events:

1) Over/undercurrent.

2) Over/undervoltage.

3) Current imbalance.

4) Phase loss, current.

5) Phase loss, voltage.

6) Voltage imbalance.

7) Over kW demand.

8) Phase reversal.

9) Digital input off/on.

10) End of incremental energy interval.

11) End of demand interval.

H. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

I. Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.

2.10 OTHER EQUIPMENT

A. Furnish tools and accessories required for circuit breaker and switchboard test, inspection, maintenance, and proper operation.

2.11 CONTROL WIRING

A. Switchboard control wires shall not be less than No. 14 AWG copper 600 volt rated. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.12 NAMEPLATES AND MIMIC BUS

A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

B. Mimic Bus: Provide an approved mimic bus on front of each switchboard assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install switchboards in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Anchor switchboards with rustproof bolts, nuts, and washers not less than 13 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.

C. In seismic areas, switchboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed

E. Interior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the

equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify appropriate anchorage, required area clearances, and correct alignment.
   d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
   e. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
   g. Vacuum-clean switchboard enclosure interior. Clean switchboard enclosure exterior.
   h. Inspect insulators for evidence of physical damage or contaminated surfaces.
   i. Verify correct shutter installation and operation.
   j. Exercise all active components.
   k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
   l. Verify that vents are clear.
2. Electrical tests:
   a. Perform insulation-resistance tests on each bus section.
   b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
   c. Perform phasing check on double-ended switchboards to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchboard is in good operating condition and properly performing the intended function.

3.4 WARNING SIGN

A. Mount on each entrance door of the switchboard room, approximately 1500 mm (5 feet) above grade or floor**,** a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.

3.5 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchboard room or in the outdoor switchboard enclosure.

B. Furnish a written sequence of operation for the switchboard and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchboard room or in the outdoor switchboard enclosure.

C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.6 AS-LEFT TRIP UNIT SETTINGS

A. The trip unit settings shall be set in the field by an authorized representative of the switchboard manufacturer per the approved Electrical System Protective Device Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.

CORC. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchboard room. Deliver four additional copies of the settings to the COR. Furnish this information prior to the activation of the switchboard.

3.7 INSTRUCTION

A. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the switchboards, on the dates requested by the COR.

---END---

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Painting of panelboards.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

H. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.

I. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices integral to panelboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

   a. Submit sufficient information to demonstrate compliance with drawings and specifications.

   b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.

c. Certification from the manufacturer that a representative panelboard has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
      1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
      2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
   IBC-21 ..... International Building Code

C. National Electrical Manufacturers Association (NEMA):
   PB 1-11 ..... Panelboards
   250-20 ..... Enclosures for Electrical Equipment (1,000V Maximum)

D. National Fire Protection Association (NFPA):
   70-23 ..... National Electrical Code (NEC)
   70E-21 ..... Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL):

50-15 ..... Enclosures for Electrical Equipment

67-09 ..... Panelboards

489-16 ..... Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.

C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.

D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.

E. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.

F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.

G. Neutral bus shall be 200%rated, mounted on insulated supports.

H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.

I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.

J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.

K. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:

1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
2. Enclosures shall not have ventilating openings.
3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:
1. Hinged "door-in-door" type.
2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.

B. Circuit breakers shall be bolt-on type.

C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
1. 120/208 V Panelboard: 10,000 A symmetrical.
2. 120/240 V Panelboard: 10,000 A symmetrical.
3. 277/480 V Panelboard: 14,000 A symmetrical.

D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame; unless otherwise indicated on drawings. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field, based on the approved protective device study as specified in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY.

E. Circuit breaker features shall be as follows:
1. A rugged, integral housing of molded insulating material.

2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.

10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

2.4 SURGE PROTECTIVE DEVICES

A. Furnish all new panelboards with integral surge protective devices. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

2.5 DIGITAL POWER METERS (DPM)

A. Furnish distribution panelboards not directly serving the telecommunication rooms/equipment with integral digital power meters.

B. ELECTRICAL METER APPLICATIONS

1. The RS-485 communications shall provide communications links up to 10,000 feet long.
2. Power meters shall be installed as part of the advanced utility metering system and as indicated in Panelboard specification “26 24 16”.
   a. All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
   b. The power meter may be applied in three-phase, three- or four- wire systems.
   c. The power meter shall be capable of being applied without modification at nominal frequencies of 50, 60, or 400 Hz.
   d. The power meter shall provide for onboard data logging, able to log data, alarms, waveforms, and events.

B. Physical and Common Requirements

1. Electrical power meters shall be separately mounted, and enclosed in a NEMA 250, Type 1 enclosure, unless where indicated on the plans to be internal to the power distribution equipment it is monitoring. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
    a. Ambient conditions of 0 to 140 deg F dry bulb and 20 to 95 percent relative humidity, noncondensing.

C. Current and voltage ratings:
1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Voltage inputs from standard instrument potential transformers with 120-volt secondary output. The power meter shall support PT primaries through 3.2 MV.
4. The power meter shall operate properly over a wide range of control power including 90-457 VAC or 100-300 VDC.

D. Electrical measurements and calculated values
1. Power meters shall include the following rms Real-Time Measurements:
    a. Current: Each phase, neutral, average of three phases, percent unbalance.
    b. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
    c. Power: Per phase and three-phase total.
    d. Reactive Power: Per phase and three-phase total.
    e. Apparent Power: Per phase and three-phase total.
    f. True Power Factor: Per phase and three-phase total.
    g. Displacement Power Factor: Per phase and three-phase total.
    h. Frequency.
    i. THD: Current and voltage.
    j. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
    k. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
    l. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

2. Power meters shall perform the following demand current calculations, per phase, three-phase average and neutral:
    a. Present.
    b. Running average.
    c. Last completed interval.
    d. Peak.
3. Power meters shall perform the following demand real power calculations, three-phase total:
    a. Present.
    b. Running average.
    c. Last completed interval.
    d. Predicted.
    e. Peak.
    f. Coincident with peak kVA demand.
    g. Coincident with kVAR demand.
4. Power meters shall perform the following demand reactive power calculations, three-phase total:
    a. Present.
    b. Running average.
    c. Last completed interval.
    d. Predicted.
    e. Peak.
    f. Coincident with peak kVA demand.
    g. Coincident with kVAR demand.
5. Power meters shall perform the following demand apparent power calculations, three-phase total:
    a. Present.
    b. Running average.
    c. Last completed interval.
    d. Predicted.
    e. Peak.
    f. Coincident with peak kVA demand.

g. Coincident with kVAR demand.

6. Power meters shall perform the following average true power factor calculations, demand coincident, three-phase total:
   a. Last completed interval.
   b. Coincident with kW peak.
   c. Coincident with kVAR peak.
   d. Coincident with kVA peak.
7. Power Analysis Values:
   a. THD, Voltage and Current: Per phase, three phase, and neutral.
   b. Displacement Power Factor: Per phase, three phase.
   c. Fundamental Voltage, Magnitude and Angle: Per phase.
   d. Fundamental Currents, Magnitude and Angle: Per phase.
   e. Fundamental Real Power: Per phase, three phase.
   f. Fundamental Reactive Power: Per phase.
   g. Harmonic Power: Per phase, three phase.
   h. Phase rotation.
   i Unbalance: Current and voltage.
   j. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.
8. Power meters shall perform one of the following demand calculations, selectable by the User; meters shall be capable of performance of all of the following demand calculations.
   a. Block interval with optional subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
      1) Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
      2) Fixed block that calculates demand at end of the interval.
      3) Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
   c. Minimum and maximum values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
      1) Line-to-line voltage.

2) Line-to-neutral voltage.
3) Current per phase.
4) Line-to-line voltage unbalance.
5) Line-to-neutral voltage unbalance.
6) Power factor.
7) Displacement power factor.
8) Total power.
9) Total reactive power.
10) Total apparent power.
11) THD voltage L-L.
12) THD voltage L-N.
13) THD current.
14) Frequency.

d. Harmonic calculation: display and record the following:
1) Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2) Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by the VA.

F. Meter accuracy:
1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
2. Accuracy from Light to Full Rating:
a. Power: Accurate to 0.5 percent of reading.
b. Voltage and Current: Accurate to 0.5 percent of reading.
c. Power Factor: Plus or minus 0.005, from 0.5 leading to 0.5 lagging.
d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

G. Meter input, sampling, display, output, recording and reading Capabilities
1. Input: One digital input signal.
a. Normal mode for on/off signal.
b. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.

c. Conditional energy signal to control conditional energy accumulation.

d. GPS time synchronization.

2. Sampling:

a. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.

b. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

3. Display Monitor:

a. Backlighted LCD to display metered data with touchscreen or touchpad selecting device.

b. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.

c. Display four values on one screen at same time.

1) Coordinate list below with meter capabilities specified in subparagraphs above.

2) Current, per phase rms, three-phase average and neutral.

3) Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.

4) Real power, per phase and three-phase total.

5) Reactive power, per phase and three-phase total.

6) Apparent power, per phase and three-phase total.

7) Power factor, per phase and three-phase total.

8) Frequency.

9) Demand current, per phase and three-phase average.

10) Demand real power, three-phase total.

11) Demand apparent power, three-phase total.

12) Accumulated energy (MWh and MVARh).

13) THD, current and voltage, per phase.

d. Reset: Allow reset of the following parameters at the display:

1) Peak demand current.

2) Peak demand power (kW) and peak demand apparent power (kVA).

3) Energy (MWh) and reactive energy (MVARh).

4. Outputs:

a. Operated either by user command sent via communication link or set to operate in response to user-defined alarm or event.
b. Closed in either a momentary or latched mode as defined by user.
c. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
d. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
e. One relay output module, providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
f. Output Relay Control:
    1) Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
    2) Normally open and normally closed contacts, field configured to operate as follows:
        a) Normal contact closure where contacts change state for as long as signal exists.
        b) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
        c) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
        d) End of power demand interval when relay operates as synchronization pulse for other devices.
        e) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
        f) Output controlled by multiple alarms using Boolean-type logic.

5. Onboard Data Logging:
    a. Store logged data, alarms, events, and waveforms in 2 MB of onboard nonvolatile memory.
    b. Stored Data:
        1) Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.

2) Custom Data Logs: three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
   a) Schedule interval.
   b) Event definition.
   c) Configured as "fill-and-hold" or "circular, first-in first-out."
3) Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
4) Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

c. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

6. Alarms.
   a. User Options:
      1) Define pickup, dropout, and delay.
      2) Assign one of four severity levels to make it easier for user to respond to the most important events first.
      3) Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
   b. Alarm Events:
      1) Over/undercurrent.
      2) Over/undervoltage.
      3) Current imbalance.
      4) Phase loss, current.
      5) Phase loss, voltage.
      6) Voltage imbalance.
      7) Over kW demand.
      8) Phase reversal.
      9) Digital input off/on.
      10) End of incremental energy interval.
      11) End of demand interval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected.

C. In seismic areas, panelboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards

E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).

F. Provide blank cover for each unused circuit breaker mounting space.

G. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims with finishes to match surrounding surfaces after the panelboards have been installed. Do not paint nameplates.

H. Rust and scale shall be removed from the inside of existing enclosures where new interior components are to be installed. Paint inside of enclosures with rust-preventive paint before the new interior components are installed. Provide new trim. Trim shall fit tight to the enclosure.

I. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify appropriate anchorage and required area clearances.

d. Verify that circuit breaker sizes and types correspond to approved shop drawings.

e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.

f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---

SECTION 26 25 11
BUSWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of busway systems for use in data center electrical distribution systems rated 600 V and below.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around busway penetrations to maintain the integrity of fire-resistant rated construction.

B. Section 07 92 00, JOINT SEALANTS: Sealing around busway penetrations through the building envelope to prevent moisture migration into the building.

D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

F. Section 26 24 16, PANELBOARDS: Circuit breakers for use in plug-in busway.

G. Section 26 29 21, ENCLOSED SWITCHES AND CIRCUIT BREAKERS: Switches and fuses for use in plug-in busway.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

   a. Submit sufficient information to demonstrate compliance with drawings and specifications.

   b. Submit the following data for approval:

      1) Electrical ratings, dimensions, mounting details and position, mounting method, vertical supports, materials, fire stops, and weatherproofing.

2) Detailed coordinated connections to equipment terminations such as switchgear, switchboards, and transformers.
3) Coordination Drawings: Submit floor plans and sections, drawn to scale. Include bus assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements. Indicate vertical and horizontal enclosed busway runs, offsets, transitions, and clearances for access above and to the side of enclosed busways. Indicate vertical elevation of busway above the floor or bottom of structure. Indicate support locations, type of support, and weight on each support.

2. Manuals:
   a. Submit complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
      1) Include information for testing, repair, troubleshooting, assembly, and disassembly.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the busway conforms to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the busway has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. International Code Council (ICC):

IBC-21.....International Building Code

C. National Electrical Manufacturers Association (NEMA):

BU 1.1-10 .....General Instructions for Handling, Installation, Operation and Maintenance of Busway Rated 600 Volts or Less

BU 1.2-13 .....Application Information for Busway Rated 600 Volts or Less

D. National Fire Protection Association (NFPA):

70-23 .....National Electrical Code (NEC)

E. Underwriters Laboratories Inc. (UL):

857-09 .....Busways

PART 2 - PRODUCTS

2.1 MATERIAL

A. Busway shall be in accordance with NEMA and UL.

B. Busway shall be rated as shown on the drawings.

C. Busway shall have the following features:

1. For indoor locations; plug-in type, totally enclosed and moisture resistant.

3. Short circuit current rating shall not be less than 42,000 A, or as required to withstand the available fault current shown on the drawings, whichever is higher.

4. 3-phase, 4-wire, with full 200% neutral.

5. Internal 100%-rated ground bus bar. Busway housing is not allowed to serve as the equipment grounding conductor.

6. All bus bars, phase, neutral, and ground, for each busway shall be within a single housing.

7. Bus Bars:

a. Shall be full round edge rectangular copper of sufficient cross-section to provide full current rating without exceeding a temperature rise of 55° C above a 40° C ambient.

b. Interconnection joints shall be tin or silver plated, with steel bolts, nuts, and Belleville washers.

c. Shall be completely insulated with flame-retardant, track-resistant, self-extinguishing insulation.

8. Housings:

a. Shall be steel or aluminum, with continuous mounting rails.

b. Shall be thoroughly cleaned and painted at the factory with primer and the manufacturer's standard finish.

c. Shall have rustproof metal hardware.

d. Provide external flanges and weatherproofing at busway entrances to buildings.

e. For busways that pass through fire-resistant rated construction, incorporate listed fire stops within the busway housings and external flanges.

f. Install expansion fittings in the busway runs in compliance with the manufacturer's standard recommendations.

g. The temperature rise at any point on the housing shall not exceed 30° C above an ambient temperature of 40° C.

9. Busway shall not be reduced in size at any point.
10. Provide manufacturer's fittings and accessories, including but not limited to elbows, tees, tap boxes, transformer taps, end boxes, expansion fittings, offsets, adapters, hangers, and mounting hardware.
11. Bus rail housing shall be of single-piece extruded aluminum that is designed to act as a 100% ground conductor. The extrusion shall have a corrosion resistant anodized surface finish. Standard lengths shall include 3, 5, 6, 10, and 12 foot. Removing the end cap assembly shall allow extending the bus run length.
12. The extruded housing must accommodate the direct insertion of hanger assemblies which attach directly to the housing assembly.
13. The complete assembly shall be of the continuous opening design and shall have a slotted opening on one side of the bus to accommodate the insertion of the Tap Off Units.

D. Dimensions and Configuration:

1. Configure within the space designated for busway installation.
2. Coordinate busway routing with equipment installation by other trades to avoid conflicts.
3. Make final field measurements and check them with the busway coordination drawings prior to authorization of fabrication of the busways.
4. The busway system shall be in accordance with the following weights: 250 Amp: 6.8 lbs/ft. [10.1 kg/m]

2.2 BUSWAY

A. Bus Bar Construction: All phase and neutral conductors shall be made of copper with a minimum of 98.9% electrical grade purity that is silver plated with a nickel undercoat per ASTM B700-08 and sized to handle a minimum of 100% of the continuously rated current. All conductors shall be electrically isolated from the housing using a Class H fiber-reinforced Glastic material with non-propagating properties. All insulators must be UL recognized. A 200%-rated Neutral shall be provided as a factory integrated feature of the bus rails.

B. Bus Power Junctions: All critical bus power junctions shall be maintenance fee. Bolted bus connections that can loosen, sag, and result in connection hotspots are not allowed.

C. Conductive Fittings and Components: All conductive fittings including Tees, Elbows, etc. shall be of the same material from the same manufacturer.

D. Insertion Points: The entire bus open channel with the exception of the small area at the bus bar coupling shall be available for Tap Off Unit insertion. The maximum busway coupler keep-out area shall be as follows: 250-400 Amp = 3.75" keep-out area

2.3 SUSPENSION AND BUS HANGERS

A. Hanger Assemblies:
   1. Assemblies shall allow ceiling mounting and must not interfere or obstruct the housing opening intended for the installation of Tap Off Units. Contractor shall supply threaded rod where required for hanging the busway.
   2. The busway shall be hung from the ceiling using threaded rod. Contractor shall be responsible for supplying the threaded rod and making connections to bus hangars and End Feed enclosures and to the supporting structure. Maximum hanger spacing will be no more than 10' on center.

B. Vertical or Horizontal Suspension
   1. Bus Hangers shall be available for vertical or horizontal bus mount applications. Hangers shall be compatible with standard hardware and Unistrut.

2.4 END FEED

A. End Feeds shall be designed for conduit landing and input feed connection. Vertical or horizontal End Feeds shall be available.

2.4 TAP OFF UNITS

A. Tap off Unit Enclosure
   1. The Tap Off Unit enclosure shall be available in vertical- and horizontal-mount configurations and shall be compatible with the 250, 400, and 800 amp bus rails. Tap Off Units used for vertical-mount supporting a maximum of two receptacles shall be available with Infrared translucent material for the purpose of thermal scanning breaker terminals. Plug-in Tap Off Units shall be polarity matched to the busway system.

B. Tap off Unit Electrical Specification
   1. The Tap Off Unit maximum amperage shall be 128A. The Tap Off Unit can support a maximum of 12 poles without BCMS monitoring or 6 poles with BCMS monitoring. Finger safe multi-pole fuse holders are optional and may be used for current limiting requirements.
   2. Unit Safety: Plug-in Tap Off Units shall have inherently safe two-step insertion and removal

in isolate sequential steps: (1) mechanically securing and then (2) energizing contact with the bus rail conductors. Plug-in Tap Off Units shall make ground contact prior to full insertion into the bus rail. The two-step insertion and removal process complements safety and change procedures at Mission Critical sites

3. Unit Monitoring: All Tap Off units shall be equipped to provide current/voltage information for Branch Circuit Monitoring System (BCMS). When equipped with the BCMS option, the Tap Off Units shall be plug-and-play. No installer wiring shall be required.

C. Circuit Breakers

1. Circuit breaker ampacity shall be appropriate for the NEMA connector circuit as indicated on drawings and maybe installed directly on the Tap Off Unit or suspended from a multi conductor cable (drop cord). Plug-in Tap Off Units shall use Square D, Eaton, Siemens, Schneider, ABB, GE, or busway manufacturer-approved circuit breakers for branch circuit protection. Minimum circuit breaker withstand rating shall be 22 kAIC

D. Connectors and Receptacles:

1. Provide connectors and receptacles as indicated on drawings. Drop cord length shall be a minimum of 6-feet; contractor shall coordinate with manufacture to provide adequate cord length as required for installation. The drop cord length shall be the length of the drop cord not including the pre-assembled connector. Plug-in Tap Off Units requiring a cord assembly shall be manufactured with cord grips and the receptacles as specified in the drawings.

2.5 BRANCH CIRCUIT MONITORING SYSTEM (BCMS)

A. BCMS Integration and Protocols: Branch Circuit Monitoring shall be optionally integrated into the busway delivering the measurement and management of the busway and Tap Off Unit loads to the customer's building management system through BacNet, Modbus RTU, Modbus TCP/IP, or SNMP protocols. Modbus TCP/IP and SNMP each require a front-end converter. The BCMS shall be integrated at the factory and shall not require any additional installed wiring between the End Feeds and Tap Off Units.

A. Monitoring Specifications: The Branch Circuit Monitoring System shall be capable of monitoring and providing all power calculations for the total input power for each busway run. It shall be housed on the outside wall of the power input. Additionally, provide a BCMS Local Display; 7" Local Touchscreen Display shall address up to 6 End Feeds, 15 Tap Off Units per End Feed or a total of 96 devices. The Display shall be wall-mounted at eye level. The Display shall not be mounted overhead on End Feeds.

1. End Feed Units monitoring and metering point shall include:
   - Voltage (L-L, L-N) for all three phases
   - Overvoltage/Undervoltage Alarm Threshold
   - Voltage THD
   - Current – Phase, Ground, and Neutral
   - Minimum & Maximum Current
   - Demand and Percent Load Current
   - Crest Factor
   - Warning and Alarm Threshold
   - kW, kVA, kVAR, Power Factor, kWH
2. Tap Off Units monitoring and metering points shall include:
   - Voltage Line-to-Line
   - Voltage Line-to-Neutral
   - Overvoltage Line-to-Neutral Alarm Threshold
   - Undervoltage Line-to-Neutral Alarm Threshold
   - Overvoltage Line-to-Line Alarm Threshold
   - Undervoltage Line-to-Line Alarm Threshold
   - Maximum Voltage Limit Line-to-Line
   - Maximum Voltage Limit Line-to-Neutral
   - Minimum Voltage Limit Line-to-Line
   - Minimum Voltage Limit Line-to-Neutral
   - Voltage Total Harmonic Distortion (THD) %F and (odd 3-21)
   - Voltage Frequency (Phase A)
   - Current per Phase
   - Current Minimum per Phase
   - Current Maximum per Phase
   - Current Demand per Phase
   - Current Percent Load per Phase
   - Crest Factor per Phase
   - Warning Threshold
   - Alarm Threshold
   - KW per Phase

- KVA per Phase
- KVAR per Phase
- Power Factor per Phase
- KWH per Phase
- Breaker trip status indication LEDs

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

B. Support busways as required by the NEC and as required by manufacturer's shop drawings.

D. Coordinate all of the busway terminations to equipment to ensure proper phasing.

E. Tighten bolted connections with a torque wrench to values as required by the manufacturer.

F. Install expansion fittings at locations where busways cross building expansion joints. Install at other locations so distance between expansion fittings does not exceed manufacturer's recommended distance between fittings.

G. Install fire-stop assemblies per Section 07 84 00, FIRESTOPPING where busways penetrate fire-resistant construction.

H. Install weatherproofing fittings and flanges where busways penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight according to Section 07 92 00, JOINT SEALANTS.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify appropriate anchorage, required area clearances, and correct alignment.
   d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
   e. Verify appropriate equipment grounding.

f. Examine outdoor busways for removal of weep-hole plugs, if applicable, and the correct installation of joint shield.

2. Electrical Tests:

a. After installation, test busway phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Resulting values shall not be less than one megohm.

3.3 FOLLOW-UP VERIFICATION

A. After the busways have been energized for a minimum of 30 days, repeat the torque wrench tightening of all bolt connections.

---END---

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. National Electrical Manufacturers Association (NEMA):

WD 1-99(R2015).....General Color Requirements for Wiring Devices

WD 6-16 .....Wiring Devices – Dimensional Specifications

C. National Fire Protection Association (NFPA):

70-17 .....National Electrical Code (NEC)

99-18 .....Health Care Facilities

D. Underwriter's Laboratories, Inc. (UL):

5-16 .....Surface Metal Raceways and Fittings

20-10 .....General-Use Snap Switches

231-16 .....Power Outlets

467-13 .....Grounding and Bonding Equipment

498-17 .....Attachment Plugs and Receptacles

943-16 .....Ground-Fault Circuit-Interrupters

1449-14 .....Surge Protective Devices

1472-15 .....Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.

1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.

B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.

1. Bodies shall be ivory in color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
3. Duplex Receptacles on Emergency Circuit:
   a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
4. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. GFCI receptacles shall be self-test receptacles in accordance with UL 943.
   a. Ground fault interrupter shall consist of a differential current transformer, self-test, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
   b. Self-test function shall be automatically initiated within 5 seconds after power is activated to the receptacles. Self-test function shall be periodically and automatically performed every 3 hours or less.
   c. End-of-life indicator light shall be a persistent flashing or blinking light to indicate that the GFCI receptacle is no longer in service.
5. Tamper-Resistant Duplex Receptacles:
   a. Bodies shall be gray in color.
      1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.

2) Screws exposed while the wall plates are in place shall be the tamperproof type.

C. Duplex Receptacles – Non-hospital Grade: shall be the same as duplex receptacles – hospital grade in accordance with sections 2.1A and 2.1B of this specification, except for the hospital grade listing.
   1. Bodies shall be brown nylon.

D. Receptacles - 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.

E. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

F. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
   1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts, and minimum single transient pulse energy dissipation of 210 Joules.
   2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

2.2 TOGGLE SWITCHES

A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
   1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
   2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self-grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
   3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

B. Color shall be ivory unless otherwise specified.

C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

E. Duplex Receptacles on Emergency Circuit: Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.

2.5 GENERATOR DOCKING STATIONS / CONNECTION BOX

A. GENERAL

1. Generator docking station is defined as CAM style male connectors and grounding terminals enclosed within a padlockable enclosure.

2. In the event the Contractor is furnishing the Generator Docking Station, the Contractor shall be responsible for the equipment until it has been installed, inspected, tested and accepted in accordance with the requirements of the specifications.

3. Generator Docking Station shall have phase rotation monitor.

B. CONSTRUCTION

1. All equipment shall be new.

2. Generator Docking Station enclosure shall be NEMA Type 4/12

a. Unit shall be constructed of 0.075" carbon steel, seamless, continuously welded, and ground smooth. Enclosure will have a flange trough collar around all sides of door opening(s).

b. Enclosure will have mounting holes in back of enclosure for wall mounting and mounting hardware with sealing washers and hole plugs shall be included.

c. Unit will have stainless steel concealed hinges with removable and interchangeable door(s) capability, padlocking handles, 3-point latching mechanisms on all forward facing doors, removable print pocket, oil & water resistant gasketing and will include ground stud on door(s) and body for grounding.

d. Unit shall also include a hinged access panel for generator CAM type connector feeder cables.

e. CAM type male connectors (inlets) shall be UL/CSA Listed single-pole and rated

at 600 amps (minimum) at 600VAC. CAM type male connectors shall be color coded to visualize appropriate voltages. CAM type male connectors shall be provided for each phase in the appropriate configuration to support required amperage and provided for neutral if required.

f. The ground CAM type male connectors shall be bonded to the enclosure and a sufficient grounding provided for the connection of the facility ground conductor. None of the CAM type inlets shall be accessible unless the hinged access panel door is open.

3. ANSI-61 gray powder coating inside and out.

4. Sub-panels may be powder coated white or bare aluminum.

C. ENCLOSURE

1. Mount: Wall Mount

2. Material: Carbon Steel

3. Finish: ANSI 61 Gray

4. Additional Requirements

a. NEMA Type 4/12

b. UL Listed/CSA Type 4 and 12

c. IEC 60529 IP 66

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Install wiring devices after wall construction and painting is complete.

C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.

D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.

E. Provide barriers in multi-gang outlet boxes to comply with the NEC.

F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish

material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.

G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes, and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.

H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.

I. Install wall dimmers 1.2 M (48 inches) above floor.

J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.

K. Install horizontally mounted receptacles with the ground pin to the right.

L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer’s required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:

1. Visual Inspection and Tests:
   a. Inspect physical and electrical conditions.
   b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
   c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
   d. Test GFCI receptacles.
2. Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

---END---

SECTION 26 29 21
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

F. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.

c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
      1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
      2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
   IBC-15 ..... International Building Code

C. National Electrical Manufacturers Association (NEMA):
   FU l-12 ..... Low Voltage Cartridge Fuses
   KS l-13 ..... Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

D. National Fire Protection Association (NFPA):
   70-17 ..... National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

98-16 ..... Enclosed and Dead-Front Switches

248 1-11 ..... Low Voltage Fuses

489-13 ..... Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.

B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.

C. Shall be horsepower (HP) rated.

D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
   a. Shall be the NEMA types shown on the drawings.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
   c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.
10. Electrically operated switches shall only be installed where shown on the drawings.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

A. Shall be the same as fused switches and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES

A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

B. Service Entrance: Class RK1, time delay.

C. Feeders: Class RK1, time delay.

D. Motor Branch Circuits: Class RK1, time delay.

E. Other Branch Circuits: Class RK1, time delay.

F. Control Circuits: Class CC, time delay.

2.6 SEPARATELY ENCLOSED CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.

B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

C. Provide with Keyed-interlock where indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

   a. Compare equipment nameplate data with specifications and approved shop drawings.

   b. Inspect physical, electrical, and mechanical condition.

c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

---END---

SECTION 26 33 53
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the static uninterruptible power supply, indicated in this section as UPS.

B. UPS System Components: The UPS system shall consist of the following main components:

   a. UPS module containing Rectifier(s), Inverter(s), Battery Charger(s), Static Bypass, and associated Control and Monitor Panel.

   b. Battery string(s) in Line-and-Match Battery Cabinets.

   c. Line-and-Match sidecar-type accessory cabinets for maintenance bypass and distribution applications.

1.2 RELATED WORK

A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. UPS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. UPS shall be factory full load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system) with AC input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.

1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, plan, front, side, and rear elevations, accessories, and device nameplate data.
   c. Provide detailed and project-specific system diagram, showing maintenance bypass, UPS module(s), battery cabinet(s) and batteries, major circuit protective devices, interconnecting power and control wiring, key-type mechanical interlocks, and connections to power sources and loads, as applicable. Indicate whether interconnections are factory-provided/factory-installed, factory-provided/field-installed, or field-provided/field installed.
   d. Certification from the manufacturer that a representative UPS has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.

2) Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
3) Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the UPS, including but not limited to bypass switchboard, UPS, key-type mechanical interlocks, remote devices, emergency power off buttons, fire alarm interface, and other components as applicable.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.

3. Test Reports:
a. Submit certified factory design and production test reports for approval.
b. Two weeks prior to the final inspection, submit certified field test reports and data sheets to the COR.

4. Certifications: Two weeks prior to final inspection, submit the following.
a. Certification by the manufacturer that the UPS conforms to the requirements of the drawings and specifications.
b. Certification by the Contractor that the UPS has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):
C57.110-08 ..... Recommended Practice for Establishing Transformer Capability When Supplying Non-Sinusoidal Load Currents

C62.41.1-02 ..... Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2-02 ..... Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

450-10 ..... Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

485-10 ..... Sizing Lead-Acid Batteries for Stationary Applications

C. International Code Council (ICC):

IBC-15 ..... International Building Code

D. National Electrical Manufacturers Association (NEMA):

PE 1-12 ..... Uninterruptible Power Systems - Specification and Performance Verification

E. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. System Capacity: Unless stated otherwise, the parameters listed are under full rated output load at a minimum of 0.9 power factor, with batteries fully charged and floating on the DC bus and with nominal input voltage. Overall kVA, N+1 redundant, at 40 °C.

B. Battery Capacity: Discharge time to end voltage: 240 minutes, at 25 °C (77 °F). Battery shall be capable of delivering 125 percent of full rated output load at initial start-up.

C. System Bus Bracing: Braced for amperes symmetrical interrupting capacity as shown on drawings.

D. AC Input:

1. Voltage 480 volts line-to-line.
2. Number of phases: 3-phase, 3-wire, plus ground.
3. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery float voltage or output voltage.
4. Frequency: 60 Hz, plus or minus 5 percent.
5. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum.

E. AC Output

1. Voltage 208 volts line-to-line, 120 volts line-to-neutral.

2. Number of phases: 3-phase, 4-wire, plus ground.
3. Voltage regulation:
    a. Balanced load: Plus or minus 1.0 percent.
    b. 100 percent load imbalance, phase-to-phase: Plus or minus 3 percent.
4. Frequency: 60 Hz.
5. Frequency regulation: Plus or minus 0.05 percent.
6. Harmonic content (RMS voltage): 5 percent maximum total harmonic distortion with 100% nonlinear load.
7. Load power factor operating range: 1.0 to 0.8 lagging.
8. Phase displacement:
    a. Balanced load: Plus or minus 1 degree of bypass input.
9. Overload capability (at full voltage) (excluding battery):
    a. 125 percent load for 10 minutes.
    b. 150 percent load for 1 minute.

F. Voltage Transient Response:
1. 100 percent load step: Plus or minus 5 percent.

2.2 UPS

A. General Description:
    a. UPS module shall consist of a rectifier/charger unit and a 3-phase inverter module unit with their associated transformers, synchronizing equipment, input and output circuit breakers, and accessories as required for operation.
    b. Unit shall be rated for 50kW and have the ability to be expanded to 150kW (ie: provide a 150kW frame). Unit minimum runtime shall be 10 minutes at full load. UPS shall be EATON 93PM UPS 50kW rated, 150kW Frame with 99% Efficiency Energy Saver System (ESS), or approved equal.

B. Rectifier/Charger Unit: Rectifier/charger unit shall be solid state and shall provide direct current to the DC bus.
1. Input Circuit Breaker: Rectifier/charger unit shall be provided with an input circuit breaker. The circuit breaker shall be sized to accept simultaneously the full-rated load and the battery recharge current.
2. Sizing: Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal AC power is restored, with the input protective device closed.

C. Inverter Unit: Inverter unit shall be a solid-state device capable of accepting power from the DC bus and providing AC power within specified limits.

1. Output Overload: The inverter shall be able to sustain an overload as specified across its output terminals.
2. Synchronism: The inverter shall normally operate in phase-lock and synchronism with the bypass source.
3. Modular Construction: Each control logic printed circuit board shall be electrically and physically packaged on an individual plug-in module with separate indication and adjustments.
4. Output Circuit Breaker: The output circuit breaker shall be capable of shunt tripping and shall have interrupting capacity as specified. Circuit breaker shall have provision for locking in the "off" position.
5. Output Transformer: The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE C57.110.

D. External Protection: UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the AC input source and/or the bypass source. The UPS system shall sustain input surges without damage in accordance with IEEE C62.41.1 and IEEE C62.41.2. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

E. Internal Protection: UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause that module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

F. Battery management system: The UPS shall contain a battery management system which has the following features when used with lead acid batteies:
   a. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Upon commissioning, battery runtime information shall be available.
   b. The battery management system shall automatically test the battery system to ensure that the battery is capable of providing greater that 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:
   c. Open battery string
   d. Shorted battery string (current limit)
   e. Battery capacity (runtime) less than 80% of “new” battery capacity

2.3 STATIC BYPASS TRANSFER SWITCH

A. A static bypass transfer switch shall be provided as an integral part of the UPS and shall consist of a static switch and a bypass protective device or bypass switch. The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass AC power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs.
   1. Static Bypass Transfer Switch Disconnect: A disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The disconnect shall be equipped with auxiliary contacts and provision for padlocking in either the "on" or "off" position.

2.4 MAINTENANCE BYPASS - SINGLE-MODULE UPS

A. A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module. The maintenance bypass switch shall provide the capability to continuously support the load from the bypass AC power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

B. The maintenance bypass switch shall provide the capability of transferring the load from the ups static bypass transfer switch to maintenance bypass and then back to the ups static bypass transfer switch with no interruption to the load.

2.5 MODULE CONTROL PANEL – SINGLE-MODULE UPS

A. The UPS module shall be provided with an LCD control/indicator panel; panel/LCD touchscreen shall be integral to UPS. Meters, controls, alarms, system diagnostics, mimic screen showing one-line diagram of the system, and indicators for operation of the UPS shall be on this panel.

1. Module Meters:
   a. Meters shall have 1 percent accuracy.
   b. The following functions shall be monitored and displayed:
      1) Input voltage, phase-to-phase (all three phases).
      2) Input current, all three phases.
      3) Input frequency.
      4) Battery voltage.
      5) Battery current (charge/discharge).
      6) Output voltage, phase-to-phase and phase-to-neutral (all three phases).
      7) Output current, all three phases.
      8) Output frequency.
      9) Output kilowatts.
      10) Elapsed time meter to indicate hours of operation, 6 digits.
      11) Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).
      12) Output kilovars.
      13) Output kilowatt hours, with 15-minute interval.
2. Module Controls:
   a. Module shall have the following controls:
      1) Alarm test/reset function.
      2) Module input protective device trip function.
      3) Module output protective device trip function.
      4) Battery protective device trip function.
      5) Emergency Power Off (EPO) pushbutton, with guard.
      6) Control power off switch.
      7) Static bypass transfer switch enable/disable selector switch.

3. Module Alarm Indicators:
   a. Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.
      1) Input AC power source failure.
      2) Input protective device open.
      3) Output protective device open.
      4) Overload.
      5) Overload shutdown.
      6) DC overvoltage.
      7) DC ground fault.
      8) Low battery.
      9) Battery discharged.
      10) Battery protective device open.
      11) Cooling fan failure.
      12) Equipment overtemperature.
      13) Control power failure.
      14) Charger off.
      15) Inverter off.
      16) Emergency off.
      17) UPS on battery.
      18) Load on static bypass.
      19) Static bypass transfer switch disabled.
      20) Inverter output overvoltage, undervoltage, overfrequency, and underfrequency.
      21) Bypass source overvoltage, undervoltage, overfrequency, and underfrequency.
      22) Bypass source to inverter out of synchronization.
      23) Inverter transformer overtemperature.

2.6 REMOTE MONITORING PANEL

A. A wall-mounted remote monitoring panel shall be provided to monitor system status.

B. Indicators: Minimum display shall include the following indicators:
   1. Load on UPS.
   2. Load on battery.

3. Load on bypass.
4. Low battery.
5. Summary alarm.
6. New alarm (to alert the operator that a second summary alarm condition has occurred).

C. Audible Alarm.

D. Any single indicator shall also turn on the audible alarm. An audible alarm test/reset button and lamp test/reset button shall be included. This reset button shall not affect nor reset the alarm on the module control panel.

2.7 BATTERY SYSTEM

A. General: A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module.

B. Battery Type: Lead calcium.

C. Battery Construction: The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.

D. Battery Cabinet: The batteries shall be furnished in a battery cabinet matching the UPS. The battery cabinet shall be provided with smoke and high temperature alarms.

E. Battery Cables: Battery-to-battery connections shall be stranded cable with proper cable supports.

F. Battery Disconnect: Each battery cabinet or rack shall have a fused disconnect switch or circuit breaker, lockable in the “off” position, provided in a NEMA 1 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The UPS shall be set in place, wired, and connected in accordance with the approved shop drawings and manufacturer's instructions.

B. In seismic areas, UPS shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the UPS manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations.

B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify appropriate anchorage, required area clearances, and correct alignment.
   d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method or performing thermographic survey after energization.
   e. Verify grounding connections.
   f. Vacuum-clean enclosure interior. Clean enclosure exterior.
   g. Verify the correct operation of all alarms and indicating devices.
   h. Attach a phase rotation meter to the UPS input, output, and bypass buses, and observe proper phase sequences.
   i. Check and test controls for proper operation.
   j. Check doors for proper alignment and operation.
   k. Check and test each protective device for proper mechanical and electrical operation.
   l. Verify protective device overcurrent trip settings against approved coordination study.
   m. Confirm correct operation and sequencing of key-type mechanical interlock systems.
2. Load Test: The UPS shall be load tested for a continuous 24-hour period by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. The UPS shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour for the following:
   a. Input voltage and current (all three phases, for each module).
   b. Input and output frequency.
   c. Battery voltage for each module.
   d. Output voltage and current (all three phases, for each module).
   e. Output kilowatts for each module.
   f. Output voltage and current (all three phases).
   g. Output kilowatts.
3. Full Load Burn in Test: The UPS shall undergo an additional full load burn-in period of 24 continuous hours by means of resistive load banks, sized for full rated output load and

provided by the UPS manufacturer. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. The following tests shall be performed:

a. With the UPS carrying full rated output load and supplied from the normal source, switch 100 percent of load bank capacity on and off a minimum of five times within the burn-in period.

b. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described above.

4. Full Load Battery Burn in Test: The UPS shall undergo a full load battery test by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. If a failure occurs during the battery discharge time, the tests shall be repeated. Instrument readings shall be recorded every half hour as above.

   a. With the UPS carrying full rated output load and operating on battery power, switch 100 percent of load bank capacity on and off a minimum of five times within the battery discharge time.

5. Battery Discharge and Recharge Test: With the battery fully charged, the UPS shall undergo a complete battery discharge test to full depletion followed by a full recharge. Instrument readings shall be recorded every minute during discharge for the following:

   a. Battery voltage and current.

   b. Output voltage and current (all three phases).

   c. Output kilowatts.

   d. Output voltage and current (all three phases).

   e. Output kilowatts (system).

   f. Output frequency.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the UPS is in good operating condition and properly performing the intended function.

3.4 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass and installed in a frame mounted near the UPS.

B. Furnish a written sequence of operation for the UPS and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass and installed in a frame mounted near the UPS.

C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the UPS, on the dates requested by the COR.

---END---

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.

B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

F. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

H. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General communications requirements that are common to more than one section in Division 27.

I. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATION SYSTEMS: Raceways for communications cabling.

J. SECTION 27 15 00, COMMUNICATIONS STRUCTURED CABLING: Communications media for interconnecting automatic transfer switches and remote control and annunciation components.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

1.4 FACTORY TESTS

A. ATS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Perform visual inspection to verify that each ATS is as specified.
2. Perform mechanical test to verify that ATS sections are free of mechanical defects.
3. Perform insulation resistance test to ensure electrical integrity and continuity of entire system.
4. Perform main switch contact resistance test.
5. Perform electrical tests to verify complete system electrical operation.

1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
   c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.
   d. Complete nameplate data, including manufacturer's name and catalog number.
   e. A copy of the markings that are to appear on the automatic transfer switches when installed.

f. Certification from the manufacturer that representative ATS have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
      2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
      1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
      2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
      3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Certifications:
   a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
   b. Two weeks prior to final inspection, submit the following.
      1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
      2) Certification by the Contractor that transfer switches have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95 ..... Emergency and Standby Power Systems for Industrial and Commercial Applications

C37.90.1-12 ..... Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

C62.41.1-02 ..... Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2-02 ..... Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C. International Code Council (ICC):

IBC-15 ..... International Building Code

D. National Electrical Manufacturers Association (NEMA):

250-14 ..... Enclosures for Electrical Equipment (1000 Volts Maximum)

ICS 6-06 ..... Enclosures

ICS 4-15 ..... Application Guideline for Terminal Blocks

MG 1-16 ..... Motors and Generators

E. National Fire Protection Association (NFPA):

70–17 ..... National Electrical Code (NEC)

99-15 ..... Health Care Facilities

110-16 ..... Emergency and Standby Power Systems

F. Underwriters Laboratories, Inc. (UL):

50-15 ..... Enclosures for Electrical Equipment

508-99 ..... Industrial Control Equipment

891-05 ..... Switchboards

1008-14 ..... Transfer Switch Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Automatic transfer switches shall comply with IEEE, NEMA, NFPA, UL, and have the following features:

1. Automatic transfer switches shall be open transition switches, 4-pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection; where ATS is installed in a building with existing ATS, contractor shall field verify existing ATS pole count and match pole count with new ATS. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
4. Ratings:
   a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
   b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
   c. Maximum automatic transfer switch rating: 800 A.
5. Markings:
   a. Markings shall be in accordance with UL 1008.
6. Tests:
   a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
7. Surge Withstand Test:
   a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
8. Housing:

a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.

9. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Contact transfer time shall not exceed six cycles.
   e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
10. Contacts:
   a. Main contacts: Silver alloy.
   b. Neutral contacts: Silver alloy, with continuous current rating not less than twice the rating of the phase contacts.
   c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
   d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
11. Manual Operator:
   a. Capable of operation by one person in either direction under no load.
12. Replaceable Parts:

a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.

b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.

13. Sensing Features:

a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.

b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.

d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

e. Test Switch: Simulate normal-source failure.

f. Switch-Position Indication: Indicate source to which load is connected.

g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.

h. Normal Power Indication: Indicate "Normal Source Available."

i. Emergency Power Indication: Indicate "Emergency Source Available."

j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.

k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.

l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.

14. Controls:

a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.

b. Controls shall control operation of the automatic transfer switches.

c. Contractor shall provide all required raceways, cabling/wiring, and appurtenances required to provide equipment communication from new ATS to existing generator control panel.

15. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

16. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panels shall have open-protocol communication capability matched with remote device.

2.2 SEQUENCE OF OPERATION

A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.

B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.

C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.

D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.

E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.

F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.

2.3 BYPASS-ISOLATION SWITCH

A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load by-pass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.

B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.

   a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.

   b. A red indicating lamp shall light when the automatic transfer switch is bypassed.

c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.

2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
   a. Interlocking: Provide interlocking as part of the bypass- isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
   b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
   c. Visual verification: The isolation blades shall be visible in the isolated position.
3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine–generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

2.4 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Include the following functions for indicated automatic transfer switches:
   1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
   2. Indication of automatic transfer switch position.
   3. Indication of automatic transfer switch in test mode.
   4. Indication of failure of communication link.
   5. Key-switch or user-code access to control functions of panel.
   6. Control of automatic transfer switch test initiation.
   7. Control of automatic transfer switch operation in either direction.
   8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of remote annunciator and control system or communication link shall not affect functions of automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.

C. Remote annunciation and control system shall include the following features:

1. Touchscreen type operator interface.
2. Control and indication means grouped together for each automatic transfer switch.
3. Label each indication and control group. Indicate the automatic transfer switch it controls, the location of the automatic transfer switch, and the identity of the load that it serves.
4. Digital Communication Capability: Matched to that of automatic transfer switches supervised.
5. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install automatic transfer switches and associated remote components in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.

B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.

C. In seismic areas, automatic transfer switches shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Mount automatic transfer switches on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

E. Anchor remote control and/or annunciator panel to wall.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Confirm correct application of manufacturer's recommended lubricants.
   d. Verify appropriate anchorage, required area clearances, and correct alignment.
   e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
   f. Verify grounding connections.
   g. Verify ratings of sensors.
   h. Vacuum-clean enclosure interior. Clean enclosure exterior.
   i. Exercise all active components.
   j. Verify that manual transfer warning signs are properly placed.
   k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
2. Electrical tests:
   a. Perform insulation-resistance tests.
   b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
      1) Test bypass-isolation unit functional modes and related automatic transfer switch operations.
      2) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
      3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
      4) Low phase-to-ground voltage shall be simulated for each phase of normal source.
      5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
      6) Verify pickup and dropout voltages by data readout or inspection of control settings.

7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.

c. Ground-fault tests: Verify that operation of automatic transfer switches shall not cause nuisance tripping or alarms of ground fault protection on either source.

d. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

3.3 FIELD SETTINGS VERIFICATION

A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.4 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the COR.

---END---

SECTION 26 41 00
FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing and installation of a complete UL master labeled lightning protection system.

1.2 RELATED WORK

A. Section 07 60 00, FLASHING AND SHEET METAL: Penetrations through the roof.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.

D. Section 26 42 00 CATHODIC PROTECTION: Requirements for protection of buried ferrous equipment from galvanic corrosion.

E. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective device installed at the electrical service entrance.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Show locations of air terminals, connections to required metal surfaces, down conductors, and grounding means.
   c. Show the mounting hardware and materials used to attach air terminals and conductors to the structure.
2. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the lightning protection system conforms to the requirements of the drawings and specifications.

b. Certification by the Contractor that the lightning protection system has been properly installed and inspected.

c. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Fire Protection Association (NFPA):

70-23 ..... National Electrical Code (NEC)

780-23 ..... Standard for the Installation of Lightning Protection Systems

C. Underwriters Laboratories, Inc. (UL):

96-16 ..... Lightning Protection Components

96A-16 ..... Installation Requirements for Lightning Protection Systems

467-22 ..... Standard for Grounding and Bonding Equipment

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Lightning protection components shall conform to NFPA 780 and UL 96, for use on Class I structures. Copper materials are required.

1. Class I conductors: Copper.
2. Class I air terminals: Solid copper, 460 mm (18 inches) long, not less than 9.5 mm (3/8 inch) diameter, with sharp bare copper points.
4. Ground rods: Copper-clad steel, 0.75 in (19 mm) diameter by 3 m (10 feet) long.
5. Ground plates: Solid copper, not less than 20 gauge.
6. Bonding plates: Bronze, 50 square cm (8 square inches).
7. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
8. Down conductor guards: Stiff copper or brass.
9. Anchors and fasteners: Bronze bolt and clamp type shall be used for all applications except for membrane roof. Adhesive type are allowed only for attachment to membrane roof materials, using adhesive that is compatible with the membrane material.

10. Connectors: Bronze clamp-type connectors shall be used for roof conductor splices, and the connection of the roof conductor to air terminals and bonding plates. Crimp-type connectors are not allowed.
11. Exothermic welds: Exothermic welds shall be used for splicing the roof conductor to the down conductors, splices of the down conductors, and for connection of the down conductors to ground rods, ground plates, and the ground ring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
B. Coordinate installation with the roofing manufacturer and roofing installer.
C. Install the conductors as inconspicuously as practical.
D. Install the down conductors within the concealed cavity of exterior walls where practical. Run the down conductors to the exterior at elevations below the finished grade.
E. Where down conductors are subject to damage or are accessible near grade, protect with down conductor guards to 2.4 m (8 feet) above grade. Bond down conductors guards to down conductor at both ends.
F. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
G. Install ground rods and ground plates not less than 600 mm (2 feet) deep and a distance not less than 900 mm (3 feet) nor more than 2.5 m (8 feet) from the nearest point of the structure. Exothermically weld the down conductors to ground rods and ground plates in the presence of the COR.
H. Bond down conductors to metal main water piping where applicable.
I. Bond down conductors to building structural steel.

J. Connect roof conductors to all metallic projections and equipment above the roof as indicated on the drawings.
K. Connect exterior metal surfaces, located within 900 mm (3 feet) of the conductors, to the conductors to prevent flashovers.
L. Maintain horizontal or downward coursing of main conductor and insure that all bends have at least an 200 mm (8 inches) radius and do not exceed 90 degrees.

M. Conductors shall be rigidly fastened every 900 mm (3 feet) along the roof and down to the building to ground.

N. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure.

O. Install air terminal bases, cable holders and other roof-system supporting means without piercing membrane or metal roofs.

P. Use through-roof connectors for penetration of the roof system. Flashing shall be provided by roofing contractor in accordance with Section 07 60 00, FLASHING AND SHEET METAL.

Q. Down conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the case of long vertical members an additional connection shall be made at intervals not exceeding 30 M (100 feet).

R. A counterpoise or ground ring, where shown, shall be of No. 1/0 copper cable having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm (2 feet) deep at a distance not less than 900 mm (3 feet) nor more than 2.5 M (8 feet) from the nearest point of the structure.

S. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for lightning to ground.

T. Where shown, use the structural steel framework or reinforcing steel as the down conductor.

1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 18 M (60 feet) intervals.
4. Install ground connections to earth at not more than 18 M (60 feet) intervals around the perimeter of the building.
5. Weld or braze bonding plates to cleaned sections of the steel and connect the conductors to the plates.

6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL 96A.

V. Where the drawings show the new lightning protection system connected to an existing lightning protection system with or without a UL master label, the new portion of the lightning protection system requires UL inspection and a Letter of Findings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Test the ground resistance to earth by standard methods, and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. A UL representative shall inspect the lightning protection system. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the COR.

---END---

SECTION 26 43 13
SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of Type 2 Surge Protective Devices, as defined in NFPA 70, and indicated as SPD in this section.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 24 16, PANELBOARDS: For factory-installed or external SPD.

C. Section 26 26 00, POWER DISTRIBUTION UNITS FOR STATIC UNINTERRUPTIBLE POWER SYSTEMS: For factory-installed or external SPD.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings and device nameplate data.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the SPD conforms to the requirements of the drawings and specifications.

b. Certification by the Contractor that the SPD has been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

IEEE C62.41.2-02 ..... Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

IEEE C62.45-08 ..... Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

C. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

UL 1283-15 ..... Electromagnetic Interference Filters

UL 1449-14 ..... Surge Protective Devices

PART 2 - PRODUCTS

2.1 SWITCHGEAR/SWITCHBOARD SPD

A. General Requirements:

1. Comply with IEEE and UL.
2. Modular design with field-replaceable modules, or non-modular design.
3. Fuses, rated at 200 kA interrupting capacity.
4. Bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
10. Four-digit transient-event counter.

B. Surge Current per Phase: Minimum 240kA per phase.

2.2 PANELBOARD SPD

A. General Requirements:

1. Comply with UL 1449 and IEEE C62.41.2.
2. Modular design with field-replaceable modules, or non-modular design.
3. Fuses, rated at 200 kA interrupting capacity.
4. Bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
10. Four-digit transient-event counter.

B. Surge Current per Phase: Minimum 120kA per phase.

2.3 ENCLOSURES

A. Enclosures: NEMA 1 or 3R – depending on installation location.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Factory-installed SPD: Switchgear, switchboard, or panelboard manufacturer shall install SPD at the factory.

C. Field-installed SPD: Contractor shall install SPD with conductors or buses between SPD and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide a circuit breaker as a dedicated disconnecting means for TVSS as shown on drawings.

D. Do not perform insulation resistance tests on switchgear, switchboards, panelboards, or feeders with the SPD connected. Disconnect SPD before conducting insulation resistance tests and reconnect SPD immediately after insulation resistance tests are complete.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify that disconnecting means and feeder size and maximum length to SPD corresponds to approved shop drawings.
   d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
   e. Vacuum-clean enclosure interior. Clean enclosure exterior.
   f. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that SPD are in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Provide the services of a factory-trained technician for one 2-hour training period for instructing personnel in the maintenance and operation of the SPD, on the date requested by the COR.

`---END---

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms “lighting fixture,” “fixture,” and “luminaire” are used interchangeably.

1.2 RELATED WORK

A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.

B. Section 02 41 00, DEMOLITION: Removal and disposal of lamps and ballasts.

C. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.

D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

G. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

    a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.

    b. Material and construction details, include information on housing and optics system.

    c. Physical dimensions and description.

    d. Wiring schematic and connection diagram.

    e. Installation details.

f. Energy efficiency data.

g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).

i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).

j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Society for Testing and Materials (ASTM):

C635/C635M REV A-13 .....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. Environmental Protection Agency (EPA):

40 CFR 261 .....Identification and Listing of Hazardous Waste

D. Federal Communications Commission (FCC):

CFR Title 47, Part 15.....Radio Frequency Devices

CFR Title 47, Part 18.....Industrial, Scientific, and Medical Equipment

E. Illuminating Engineering Society of North America (IESNA):

LM-79-08 ..... Electrical and Photometric Measurements of Solid-State Lighting Products

LM-80-15 ..... Measuring Lumen Maintenance of LED Light Sources

LM-82-12 ..... Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

F. Institute of Electrical and Electronic Engineers (IEEE):

C62.41-91(R1995) ..... Surge Voltages in Low Voltage AC Power Circuits

G. International Code Council (ICC):

IBC-15 ..... International Building Code

H. National Electrical Manufacturer's Association (NEMA):

C78.376-14 ..... Chromaticity of Fluorescent Lamps

C82.1-04(R2015) ..... Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts

C82.2-02(R2016) ..... Method of Measurement of Fluorescent Lamp Ballasts

C82.4-17 ..... Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

C82.11-17 ..... Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts

LL 9-11 ..... Dimming of T8 Fluorescent Lighting Systems

SSL 1-16 ..... Electronic Drivers for LED Devices, Arrays, or Systems

I. National Fire Protection Association (NFPA):

70-17 ..... National Electrical Code (NEC)

101-18 ..... Life Safety Code

J. Underwriters Laboratories, Inc. (UL):

496-17 ..... Lampholders

542-05 ..... Fluorescent Lamp Starters

844-12 ..... Luminaires for Use in Hazardous (Classified) Locations

924-16 ..... Emergency Lighting and Power Equipment

935-01 ..... Fluorescent-Lamp Ballasts

1029-94 ..... High-Intensity-Discharge Lamp Ballasts

1029A-06 ..... Ignitors and Related Auxiliaries for HID Lamp Ballasts

1598-08 ..... Luminaires

1574-04..... .....Track Lighting Systems

2108-15.....Low-Voltage Lighting Systems

8750-15.....Light Emitting Diode (LED) Light Sources for Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

E. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

F. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectance, except where otherwise shown on the drawing.

3. Exterior finishes shall be as shown on the drawings.

G. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

H. Light Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.

I. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

2.2 LED EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.

B. Housing and door shall be die-cast aluminum.

C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.

D. Finish shall be satin or fine grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

2.3 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
   a. Minimum efficiency: 85% at full load.
   b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
   c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
   d. Integral short circuit, open circuit, and overload protection.
   e. Power Factor: ≥ 0.95.
   f. Total Harmonic Distortion: ≤ 20%.
   g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
   a. Comply with IES LM-79 and LM-80 requirements.
   b. Minimum CRI 80 and color temperature 3000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
   c. Minimum Rated Life: 50,000 hours per IES L70.
   d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:
   1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:
   1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
   2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.

B. Align, mount, and level the lighting fixtures uniformly.

C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20-gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.

D. Lighting Fixture Supports:

1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
4. Hardware for recessed fluorescent fixtures:
   a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
   b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
   a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6 mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
   b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6 mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6 mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
6. Hardware for recessed lighting fixtures:
   a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
   b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist

spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel, or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.

c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
   1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12-gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
   2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.

d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

7. Surface mounted lighting fixtures:
   a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12-gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
   b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
    1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
    2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
    3) The outlet box is supported vertically from the building structure.
d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.

8. Single or double pendant-mounted lighting fixtures:
    a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine-gauge wire hanger and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.

G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.

I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT, and Section 02 41 00, DEMOLITION.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform the following:

1. Visual Inspection:

   a. Verify proper operation by operating the lighting controls.

   b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.

2. Electrical tests:

   a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the COTR. Observe for visually detectable flicker over full dimming range and replace defective components at no cost to the Government.

   b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes common requirements to communications installations and applies to all sections of Division 27 and Division 28.

B. Provide completely functioning communications systems.

C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

1.2 REFERENCES

A. Abbreviations and Acronyms

1. Refer to http:www.cfm.va.gov/til/sdetail.asp for Division 00, ARCHITECTURAL ABBREVIATIONS.
2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station

CAD	AutoCAD
CBOPC	Community Based Out Patient Clinic
CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)
CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management
CFR	Consolidated Federal Regulations
CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) – Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)

EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System
GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition Digital Television
HEC	Head End Cabinets(refer to HEIC, PA)
HEIC	Head End Interface Cabinets(refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical

IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megaherts (10^6 Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room
NRTL	OSHA Nationally Recognized Testing Laboratory
NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration
OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health

OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
RPEC	Radio Paging Equipment Cabinets(refer to HEC, HEIC, PA)
RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)

SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)
UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet
V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office
VAMC	VA Medical Center (refer to CBOC, OPC, VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)

VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Radio
W	Watts
WEB	World Electronic Broadcast
WiMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. Distributed (in house) Antenna System (DAS): An Emergency Radio Communications System installed for Emergency Responder (or first responders and Government personnel) use while inside facility to maintain contact with each respective control point; refer to Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEMS.
8. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
9. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.

10. Electrical Supervision: Analyzing a system's function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
11. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
12. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR equipment authorized or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations, and is a required standard capability for all LMR equipment and systems.
13. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
14. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
15. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
16. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
17. Microducts: All forms of air blown fiber pathways.
18. Ohm: A unit of restive measurement.
19. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
20. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
21. Sound (SND): Changing air pressure to audible signals over given time span.
22. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.

23. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm2 [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
24. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
25. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

1.3 APPLICABLE PUBLICATIONS

A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
   1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.
   2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.

B. Government Codes, Standards and Executive Orders: Refer to http:www.cfm.va.gov/TIL/cPro.asp:
   1. Federal Communications Commission, (FCC) CFR, Title 47:

Part 15	Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations
Part 47	Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment
Part 58	Television Broadcast Service

Part 73	Radio and Television Broadcast Rules
Part 90	Rules and Regulations, Appendix C
Form 854	Antenna Structure Registration
Chapter XXIII	National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book'– Chapters 7, 8 & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations

2. US Department of Agriculture, (Title 7, USC, Chapter 55, Sections 2201, 2202 & 2203:RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction:

RUS Bull 1751F-630	Design of Aerial Cable Plants
RUS Bull 1751F-640	Design of Buried Cable Plant, Physical Considerations
RUS Bull 1751F-643	Underground Plant Design
RUS Bull 1751F-815	Electrical Protection of Outside Plants,
RUS Bull 1753F-201	Acceptance Tests of Telecommunications Plants (PC-4)
RUS Bull 1753F-401	Splicing Copper and Fiber Optic Cables (PC-2)
RUS Bull 345-50	Trunk Carrier Systems (PE-60)
RUS Bull 345-65	Shield Bonding Connectors (PE-65)
RUS Bull 345-72	Filled Splice Closures (PE-74)
RUS Bull 345-83	Gas Tube Surge Arrestors (PE-80)

3. US Department of Commerce/National Institute of Standards Technology,(NIST):

FIPS PUB 1-1	Telecommunications Information Exchange
FIPS PUB 100/1	Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit
FIPS PUB 140/2	Telecommunications Information Security Algorithms
FIPS PUB 143	General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment
FIPS 160/2	Electronic Data Interchange (EDI),
FIPS 175	Federal Building Standard for Telecommunications Pathway and Spaces
FIPS 191	Guideline for the Analysis of Local Area Network Security

FIPS 197	Advanced Encryption Standard (AES)
FIPS 199	Standards for Security Categorization of Federal Information and Information Systems

4. US Department of Defense, (DoD):

MIL-STD-188-110	Interoperability and Performance Standards for Data Modems
MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-115	Communications Timing and Synchronizations Subsystems
MIL-C-28883	Advanced Narrowband Digital Voice Terminals
MIL-C-39012/21	Connectors, Receptacle, Electrical, Coaxial, Radio Frequency, (Series BNC (Uncabled), Socket Contact, Jam Nut Mounted, Class 2)

5. US Department of Health and Human Services:
   The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules
6. US Department of Justice:
   2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).
7. US Department of Labor, (DoL) - Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):

Subpart 7	Approved NRTLs; obtain a copy at https:www.osha.gov/dts/otpca/nrtl/nrtllist.html
Subpart 35	Compliance with NFPA 101, Life Safety Code
Subpart 36	Design and Construction Requirements for Exit Routes
Subpart 268	Telecommunications
Subpart 305	Wiring Methods, Components, and Equipment for General Use
Subpart 508	Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities

8. US Department of Transportation, (DoT):
   a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 – Antenna Construction Registration Forms.

9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
   a. CoG, "Continuance of Government" communications guidelines and compliance.
   b. COMSEC,"VA wide coordination and control of security classified communication assets."
   c. COOP, "Continuance of Operations" emergency communications guidelines and compliance.
   d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."
   e. Handbook 6100 – Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 – Information Security Program.
   f. Low Voltage Special Communications Systems "Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems)."
   g. SATCOM, "Satellite Communications" guidelines and compliance, and Security and Law Enforcement Systems – "Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.
   h. VHA's National Center for Patient Safety – Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
   i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.
   j. Wireless and Handheld Devices, "Guidelines and Compliance,"
   k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.

C. NRTL Standards: Refer to https:www.osha.gov/laws-regs/regulations/standardnumber/1926
   1. Canadian Standards Association (CSA); same tests as presented by UL
   2. Communications Certifications Laboratory (CEL); same tests as presented by UL.

3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
4. Underwriters Laboratory (UL):

1-2005	Flexible Metal Conduit
5-2011	Surface Metal Raceway and Fittings
6-2007	Rigid Metal Conduit
44-010	Thermoset-Insulated Wires and Cables
50-1995	Enclosures for Electrical Equipment
65-2010	Wired Cabinets
83-2008	Thermoplastic-Insulated Wires and Cables
96-2005	Lightning Protection Components
96A-2007	Installation Requirements for Lightning Protection Systems
360-2013	Liquid-Tight Flexible Steel Conduit
444-2008	Communications Cables
467-2013	Grounding and Bonding Equipment
486A-486B-2013	Wire Connectors
486C-2013	Splicing Wire Connectors
486D-2005	Sealed Wire Connector Systems
486E-2009	Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-2007	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
497/497A/497B/497C	
497D/497E	Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In
510-2005	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE Conduit

797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1069-2007	Hospital Signaling and Nurse Call Equipment
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666-2007	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
1685-2007	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861-2012	Communication Circuit Accessories
1863-2013	Standard for Safety, communications Circuits Accessories
1865-2007	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024-2011	Standard for Optical Fiber Raceways
2024-2014	Standard for Cable Routing Assemblies and Communications Raceways
2196-2001	Standard for Test of Fire Resistive Cable
60950-1 ed. 2-2014	Information Technology Equipment Safety

D. Industry Standards:

1. Advanced Television Systems Committee (ATSC):

A/53 Part 1: 2013	ATSC Digital Television Standard, Part 1, Digital Television System
A/53 Part 2: 2011	ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics
A/53 Part 3: 2013	ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics
A/53 Part 4: 2009	ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics
A/53 Part 5: 2014	ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics

A/53 Part 6: 2014	ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics

2. American Institute of Architects (AIA): 2006 Guidelines for Design & Construction of Health Care Facilities.
3. American Society of Mechanical Engineers (ASME):

A17.1 (2013)	Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices
17.3 (2011)	Safety Code for Existing Elevators and Escalators
17.4 (2009)	Guide for Emergency Personnel
17.5 (2011)	Elevator and Escalator Electrical Equipment

4. American Society for Testing and Materials (ASTM):

B1 (2001)	Standard Specification for Hard-Drawn Copper Wire
B8 (2004)	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
D1557 (2012)	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3 (2,700 kN-m/m3)
D2301 (2004)	Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
B258-02 (2008)	Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
D709-01(2007)	Standard Specification for Laminated Thermosetting Materials
D4566 (2008)	Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at https:ebiznet.sbc.com/sbcnebs/

ATT-TP-76200 (2013)	Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
ATT-TP-76300(2012)	Merged AT&T Affiliate Companies Installation Requirements

ATT-TP-76305 (2013)	Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways
ATT-TP-76306 (2009)	Electrostatic Discharge Control
ATT-TP-76400 (2012)	Detail Engineering Requirements
ATT-TP-76402 (2013)	AT&T Raised Access Floor Engineering and Installation Requirements
ATT-TP-76405 (2011)	Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments
ATT-TP-76416 (2011)	Grounding and Bonding Requirements for Network Facilities
ATT-TP-76440 (2005)	Ethernet Specification
ATT-TP-76450 (2013)	Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces
ATT-TP-76461 (2008)	Fiber Optic Cleaning
ATT-TP-76900 (2010)	AT&T Installation Testing Requirement
ATT-TP-76911 (1999)	AT&T LEC Technical Publication Notice

6. British Standards Institution (BSI):

BS EN 50109-2	Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997

7. Building Industry Consulting Service International(BICSI):

ANSI/BICSI 002-2011	Data Center Design and Implementation Best Practices
ANSI/BICSI 004-2012	Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
ANSI/NECA/BICSI 568-2006	Standard for Installing Commercial Building Telecommunications Cabling
NECA/BICSI 607-2011	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
ANSI/BICSI 005-2013	Electronic Safety and Security (ESS) System Design and Implementation Best Practices

8. Electronic Components Assemblies and Materials Association,(ECA).

ECA EIA/RS-270 (1973)Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification

EIA/ECA 310-E (2005) Cabinets, and Associated Equipment

9. Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.

10. Insulated Cable Engineers Association (ICEA):

ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems

ANSI/ICEA S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable

ANSI/ICEA S-90-661-2012 Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems

S-98-688 (2012) Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors

S-99-689 (2012) Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors

ICEA S-102-700 (2004) Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements

11. Institute of Electrical and Electronics Engineers (IEEE):

ISSN 0739-5175 March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks

IEEE C2-2012 National Electrical Safety Code (NESC)

C62.41.2-2002/

Cor 1-2012 IEEE	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
C62.45-2002	IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
81-2012 IEEE	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
100-1992	IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
602-2007	IEEE Recommended Practice for Electric Systems in Health Care Facilities
1100-2005	IEEE Recommended Practice for Powering and Grounding Electronic Equipment

12. International Code Council:

AC193 (2014)	Mechanical Anchors in Concrete Elements

13. International Organization for Standardization (ISO):

ISO/TR 21730 (2007)	Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices

14. National Electrical Manufacturers Association (NEMA):

NEMA 250 (2008)	Enclosures for Electrical Equipment (1,000V Maximum)
ANSI C62.61 (1993)	American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
ANSI/NEMA FB 1 (2012)	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
ANSI/NEMA OS 1 (2009)	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA SB 19 (R2007)	NEMA Installation Guide for Nurse Call Systems
TC 3 (2004)	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE 2 (2006)	Cable Tray Installation Guidelines

15. National Fire Protection Association (NFPA):

70E-2015	Standard for Electrical Safety in the Workplace

70-2014	National Electrical Code (NEC)
72-2013	National Fire Alarm Code
75-2013	Standard for the Fire Protection of Information Technological Equipment
76-2012	Recommended Practice for the Fire Protection of Telecommunications Facilities
77-2014	Recommended Practice on Static Electricity
90A-2015	Standard for the Installation of Air Conditioning and Ventilating Systems
99-2015	Health Care Facilities Code
101-2015	Life Safety Code
241	Safeguarding construction, alternation and Demolition Operations
255-2006	Standard Method of Test of Surface Burning Characteristics of Building Materials
262 - 2011	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
780-2014	Standard for the Installation of Lightning Protection Systems
1221-2013	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
5000-2015	Building Construction and Safety Code

16. Society for Protective Coatings (SSPC):

    SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

17. Society of Cable Telecommunications Engineers (SCTE):

ANSI/SCTE 15 2006	Specification for Trunk, Feeder and Distribution Coaxial Cable

18. Telecommunications Industry Association (TIA):

TIA-120 Series	Telecommunications Land Mobile communications (APCO/Project 25) (January 2014)
TIA TSB-140	Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
TIA-155	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)

TIA TSB-162-A	Telecommunications Cabling Guidelines for Wireless Access Points (2013)
TIA-222-G	Structural Standard for Antenna Supporting Structures and Antennas (2014)
TIA/EIA-423-B	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)
TIA-455-C	General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014)
TIA-455-53-A	FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)
TIA-455-61-A	FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)
TIA-472D000-B	Fiber Optic Communications Cable for Outside Plant Use (July 2007)
ANSI/TIA-492-B	62.5-µ Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009)
ANSI/TIA-492AAAB-A	50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009
TIA-492CAAA	Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers (September 2002)
TIA-492E000	Sectional Specification for Class IVd Nonzero- Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002)
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008)
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998)

TIA-568	Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas
TIA-569	Revision/Edition C Telecommunications Pathways and Spaces (March 2013)
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
TIA-598-D	Optical Fiber Cable Color Coding (January 2005)
TIA-604-10-B	Fiber Optic Connector Intermateablility Standard (August 2008)
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure (2012)
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard (April 2011)

TIA-942-A	Telecommunications Infrastructure Standard for Data Centers (March 2014)
TIA-1152	Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009)
TIA-1179	Healthcare Facility Telecommunications Infrastructure Standard (July 2010)

1.4 SINGULAR NUMBER

A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

1.5 RELATED WORK

A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.

1. Field Cutting and Patching: Section 09 91 00, PAINTING.
2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13,SUSTAINABLE DESIGN REQUIREMENTS.
7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).

11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
13. Wiring devices: Section 26 27 26, WIRING DEVICES.
14. Underground ducts, raceways, precast manholes and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.
15. Lightning protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
16. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
17. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
18. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
19. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
20. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
21. Detection and screening systems: Section 28 13 53, SECURITY ACCESS DETECTION.
22. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.
23. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
24. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment: Section 28 26 00, ELECTRONIC PERSONAL PROTECTION EQUIPMENT AND SYSTEMS.
25. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.

26. Emergency Call telephones, intercom systems, with blue strobe light and equipment: Section 28 52 31, SECURITY EMERGENCY CALL/DURESS ALARM/COMMUNICATIONS SYSTEM AND EQUIPMENT.

1.6 ADMINISTRATIVE REQUIREMENTS

A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.

B. Be proactive in scheduling work.

1. Use of premises is restricted at times directed by COR.
2. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Plan for large equipment requiring positioning prior to closing in building.
5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.

D. Communications Project Manager Responsibilities:

1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
2. Coordinate with related work indicated on drawings or specified.
3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

1.7 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Provide parts list including quantity of spare parts.

C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.

D. Provide Source Quality Control Submittal:

1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.

E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:

1. Installation location and name.
2. Owner’s name and contact information including, address, telephone and email.
3. Date of project start and date of final acceptance.
4. System project number.
5. Three paragraph description of each system related to this project; include function, operation, and installation.

F. Provide delegated design submittals (e.g. seismic support design).

G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.

H. Test Equipment List:

1. Supply test equipment of accuracy better than parameters to be tested.
2. Submit test equipment list including make and model number:
   a. ANSI/TIA-1152 Level IV twisted pair cabling test instrument.
   b. Fiber optic insertion loss power meter with light source.

c. Optical time domain reflectometer (OTDR).
d. Volt-Ohm meter.
e. Digital camera.
f. Bit Error Test Set (BERT).
g. Signal level meter.
h. Time domain reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
i. Spectrum analyzer.
j. Color video monitor with audio capability.
k. Video waveform monitor.
l. Video vector scope.
m. 100 MHz oscilloscope with video adapters.

3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.
4. Provide sample test and evaluation reports.

I. Submittal Drawings:

1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
   a. Telecommunications rooms.
   b. Building Entrance Facility/Demarcation rooms.
   c. Server rooms/Data Center.
   d. Equipment rooms.
   e. Antenna Head End rooms.
2. Logical Drawings: Provide logical riser or schematic drawings for all systems.
   a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

J. Provide sustainable design submittals.

K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.8 CLOSEOUT SUBMITTALS

A. Provide following closeout submittals prior to project closeout date:
   1. Warranty certificate.
   2. Evidence of compliance with requirements such as low voltage certificate of inspection.
   3. Project record documents.
   4. Instruction manuals and software that are a part of system.

B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1. Prepare a manual for each system and equipment specified.
   2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
   3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
   4. Furnish remaining manuals prior to final completion.
   5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
   6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
   7. Provide a Table of Contents and assemble files to conform to Table of Contents.
   8. Operation and Maintenance Data includes:
      a. Approved shop drawing for each item of equipment.
      b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
      c. A control sequence describing start-up, operation, and shutdown.
      d. Description of function of each principal item of equipment.
      e. Installation and maintenance instructions.
      f. Safety precautions.
      g. Diagrams and illustrations.
      h. Test Results and testing methods.
      i. Performance data.

j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.

k. Warranty documentation indicating end date and equipment protected under warranty.

l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

C. Record Wiring Diagrams:

1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.

2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24” x 36”) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1’ 0 inch).

3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.

4. Floor plans to include:

a. Final room numbers and actual backbone cabling and pathway locations and labeling.

b. Inputs and outputs of equipment identified according to labels installed on cables and equipment

c. Device locations with labels.

d. Conduit.

e. Head-end equipment.

f. Wiring diagram.

g. Labeling and administration documentation.

5. Submit Record Wiring Diagrams within five business days after final cable testing.

6. Deliver Record Wiring Diagrams as CAD files in .dwg or Revit formats as determined by COR.

7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.

D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. After approval and prior to installation, furnish COR with the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
2. One coupling, bushing and termination fitting for each type of conduit.
3. Samples of each hanger, clamp and supports for conduit and pathways.
4. Duct sealing compound.

1.10 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.

B. Product and System Qualification:

1. OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.
2. Government reserves the right to require a list of installations where products have been in operation before approval.
3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.

C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.

D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.

E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.

F. Manufactured Products:

1. Comply with FAR clause 52.236-5 for material and workmanship.
2. When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
3. Equipment Assemblies and Components:
   a. Components of an assembled unit need not be products of same manufacturer.
   b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
   c. Provide compatible components for assembly and intended service.
   d. Constituent parts which are similar must be product of a single manufacturer.
4. Identify factory wiring on equipment being furnished and on wiring diagrams.

G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.
   1. When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
   2. Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.

B. Storage and Handling Requirements:
   1. Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
      a. Store and protect equipment in a manner that precludes damage or loss, including theft.
      b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
      c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.

C. Coordinate storage.

1.12 FIELD CONDITIONS

A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

1.13 WARRANTY

A. Comply with FAR clause 52.246-21, except as follows:

1. Warranty material and equipment to be free from defects, workmanship, and remain so for a period of one year for Emergency Systems from date of final acceptance of system by Government; provide OEM's equipment warranty document to COR. If a manufacturers warranty extends past the one year requirement the Contractor shall provide that warranty to the Government.
2. Government maintenance personnel must have ability to contact OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time; contractor and OEM must provide this capability.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.

B. In cases of renovations in historic or otherwise restrictive buildings, where it has been determined as impossible to follow above stated guidelines, exceptions must not modify maximum distances set forth in TIA 568 and 569; and exceptions must not in any way effect performance of entire TIP system.

C. Modification to administrative issues requires written approvals from COR with concurrence from SMCS 005OP2H3, OEM, contractor, and local authorities.

2.2 EQUIPMENT IDENTIFICATION

A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.

B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

2.3 UNDERGROUND WARNING TAPE

A. Underground Warning: Standard 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type; red with black letters imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”, orange with black letters imprinted with “CAUTION BURIED TELEPHONE LINE BELOW” or orange with black letters imprinted with “CAUTION BURIED FIBER OPTIC LINE BELOW”, as applicable.

2.4 WIRE LUBRICATING COMPOUND

A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

2.5 FIREPROOFING TAPE

A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.

B. Tape must be self-extinguishing and cannot support combustion; arc-proof and fireproof.

C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.

D. Application must withstand a 200-ampere arc for minimum 30 seconds.

E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

2.6 UNDERGROUND CABLES

A. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound.

B. Provide closure of adequate strength to protect splice and maintain cable shield electrical continuity in buried environment.

C. Provide re-enterable encapsulating compound maintaining chemical stability of closure.

D. Provide filled splice cases in accordance with RUS Bull 345-72.

E. Provide gel filled cable meeting requirements of ICEA S-99-689 and RUS 1755.390.

F. In Vault or Manhole:

1. Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound

2. Closure must be suitable thermoplastic, thermo-set, or stainless steel material supplying structural strength to pass mechanical and electrical requirements in a vault or maintenance hole (manhole) environment.

G. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.

H. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

PART 3 - EXECUTION

3.1 PREPARATION

A. Penetrations and Sleeves:

1. Lay out penetration and sleeve openings in advance, to permit provision in work.
2. Set sleeves in forms before concrete is poured.
3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.
6. Fill slots, sleeves and other openings in floors or walls if not used.
   a. Fill spaces in openings after installation of conduit or cable.
   b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
   c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
12. Do not support piping risers or conduit on sleeves.
13. Identify unused sleeves and slots for future installation.
14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.

B. Core Drilling:
   1. Avoid core drilling whenever possible.
   2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
   3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
   4. Protect areas from damage.
C. Verification of In-Place Conditions:
   1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
      a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
      b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
   2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
      a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
      b. Do not proceed with utility interruptions without Government's written permission.
D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.
E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.
F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.
G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

3.2 INSTALLATION - GENERAL

A. Coordinate systems, equipment, and materials installation with other building components.
B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.

C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.

E. Install equipment according to manufacturers' written instructions.

F. Install wiring and cabling between equipment and related devices.

G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.

H. Provide access panel or doors where units are concealed behind finished surfaces.

I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.

J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.

K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.

L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.

M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.

N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

3.3 EQUIPMENT INSTALLATION

A. Locate equipment as close as practical to locations shown on drawings.

B. Note locations of equipment requiring access on record drawings.

C. Access and Access Panels: Verify access panel locations and construction with COR.

D. Inaccessible Equipment:

1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.

2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.
3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

3.4 EQUIPMENT IDENTIFICATION

A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
B. Secure identification signs with screws.

3.5 CUTTING AND PATCHING

A. Perform cutting and patching according to contract general requirements and as follows:
   1. Remove samples of installed work as specified for testing.
   2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
   3. Remove and replace defective work.
   4. Remove and replace non-conforming work.
B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
D. Protect adjacent installations during cutting and patching operations.
E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

3.6 FIELD QUALITY CONTROL

A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.
B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.
C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and

patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.

1. Protect facility, equipment, and wiring from damage.

D. Submit written notice that:

1. Project has been inspected for compliance with documents.
2. Work has been completed in accordance with documents.

E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.

F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.

1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:

1. Interim inspection is required at approximately 50 percent of installation.
2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.

5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B pin assignments and cabling connections are in compliance with TIA standards.
6. Visually confirm minimum Category 6A cable marking at TCOs, CCSs locations, patch cords and origination locations.
7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
8. Review cable tray, conduit and path/wire way installation practice.
9. OEM and contractor to perform:
    a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.

10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
11. Provide results of interim inspections to COR.
12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
    a. Additional inspections are scheduled at direction of COR.
    b. Re-inspection of deficiencies noted during interim inspections, must be part of system's Final Acceptance Proof of Performance Test.
    c. The interim inspection cannot affect the system's completion date unless directed by COR.
13. Facility COR will ensure test documents become a part of system's official documentation package.

    .

    a. Utility provider entrance.
    b. Buried conduit duct locations.
    c. Maintenance Holes (Manholes) and hand holes.
    d. ENTR or DEMARC.
    e. TR interconnections.
    f. System interfaces in locations listed herein.
    g. Emergency generator interconnections.

h. Each general floor areas.

i. Others as required by AHJ (SMCS 005OP2H3).

14. Provide recorded system pretest measurements and certification that the system is ready for formal acceptance test to COR.

H. Acceptance Test:

1. Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
2. Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
3. Test in the presence of the following:
   a. COR.
   b. OEM representatives.
   c. VACO:
      1) CFM representative.
      2) AHJ–SMCS 005OP2H3, (202)461-5310.
   d. VISN–CIO, Network Officer and VISN representatives.
   e. Facility:
      1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      2) OI&T Service Chief and OI&T representatives.
      3) Safety Officer, Police Chief and facility safety representatives.
   f. Local Community Safety Personnel:
      1) Fire Marshal representative.
      2) Disaster Coordinator representative.
      3) EMS Representatives: Police, Sherriff, City, County or State representatives.
4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
   a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
      1) Demonstrate and verify that system complies with performance requirements under operating conditions.

2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.

3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.

4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.

I. Acceptance Test Procedure:

1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
2. A system inventory including available spare parts must be taken at this time.
3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.

J. Operational Test:

1. Individual Item Test: VACO AHJ representative (SMCS 005OP2H3) may select individual items of equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet requirements of the construction documents.
2. Government's Condition of Acceptance of System Language:
   a. Without Acceptance: Until system fully meets conditions of construction documents, system's ownership, use, operation and warranty commences at Government's final acceptance date.
   b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system's use and operation to commence immediately while its warranty commences only at Government's agreed final extended acceptance date.

c. With Full Acceptance: Stating system's ownership, use, operation and warranty to immediately commence at Government's agreed to date of final acceptance.

K. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of the test, using the generated punch list or discrepancy list. Perform retesting to comply with these specifications at contractor's expense.

L. Proof of Performance Certification:

1. If system is declared acceptable, AHJ (SMCS 005OP2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

3.7 CLEANING

A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.

B. Put building and premises in neat and clean condition.

C. Remove debris on a daily basis.

D. Remove unused material, during progress of work.

E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.

F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.

G. Perform final cleaning prior to project acceptance by COR.

H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.

I. Clean devices internally using methods and materials recommended by manufacturer.

J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment

connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

3.8 TRAINING

A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Provide training for equipment or system as required in each associated specification.

C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

3.9 PROTECTION

A. Protection of Fireproofing:

1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.

B. Maintain equipment and systems until final acceptance.

C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

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SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies grounding and bonding requirements of communications installations based on the requirements of ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises. Work covered by this Section shall consist of furnishing supplies, labor, materials, equipment, labeling, and tools. Testing is required unless otherwise specified. An operable grounding and bonding infrastructure is required as described on the Drawings and/or required by these specifications. All materials shall be listed by a nationally recognized testing laboratory (NRTL). All telecommunications grounding and bonding materials will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Required Bonding Busbars.

B. Supplemental Bonding Networks.

C. Telecommunications Bonding Conductors.

D. Joining Requirements.

E. Overvoltage Surge Protectors.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

B. ANSI/TIA-607-D, Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

C. NFPA 70, National Electrical Code (NEC).

D. International Annealed Copper Standard (IACS).

E. BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.

F. UL 497 & UL 497A, UL Standards for Primary & Secondary Safety Protectors for Paired-Conductor Communications Circuits.

1.4 RELATED WORK

A. Facility grounding and bonding requirements: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Information Technology equipment enclosures: Section 27 11 16, COMMUNICATION CABINETS, RACKS, FRAMES, AND ENCLOSURES.

C. Cable trays: Section 27 05 36, CABLE TRAYS FOR COMMUNICATIONS SYS

D. Provide riser diagram indicating location of communications grounding system connections indicating routing of grounding conductors.

E. Closeout Submittals: Provide test reports of ground resistance to each primary or secondary bonding busbar (PBB/SBB) located in each telecommunications space impacted by the work.

PART 2 - PRODUCTS

2.1 BONDING BUSBARS.

Bonding busbars are located in each telecommunications space and in each network rack/cabinet. Bonding busbars provide common locations in the telecommunications space for the connection of the telecommunications bonding conductors.

A. Common Requirements.

1. Provided with holes for use with correctly matched UL Listed two-hole lugs and hardware.
2. Constructed of copper or copper alloy with a minimum of 95% conductivity when annealed.
3. Annealed as specified by the International Annealed Copper Standard (IACS).
4. Installation resulting in a maximum 4.0Ω to ground resistance measured from any point in the system.
5. Installation is insulated from the mounting surface through the use of appropriate insulators.
6. UL Listed.

B. Primary Bonding Busbar (PBB). The PBB is a dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The PBB also serves as the central attachment point for Secondary Bonding Busbars (SBB) via Telecommunications Bonding Backbone (TBB).

1. Pre-drilled copper with holes to accommodate lug mounting holes.
2. Sized for current applications and future growth.
3. Insulated from its supports.
4. Electro-tin plated is acceptable.
5. Maintain a 2” min clearance between busbar and finished wall.
6. Size must be 0.25” thick by 4” wide by 20” length.

C. Secondary Bonding Busbar (SBB). The SBB is a common point of connection for telecommunications system and equipment bonding to a ground located in each Telecommunications Room.
   1. Pre-drilled holes to accommodate dual-lug mounting holes.
   2. 0.25” thick x 2” wide with varying length to be sized for current applications and future growth.
   3. Maintain a 2” min clearance between the finished wall and busbar.
   4. Copper or tin annealed copper.

D. Rack Bonding Busbar (RBB). The RBB is a busbar located in a cabinet, rack, or frame.
   1. Mounting. Horizontal mounting to an EIA-310-D 19” equipment rack is specified.
   2. Capacity: 10 Double-hole lugs.
   3. Size & material 0.75” wide x 19” length x 0.25” thick – Copper or tin annealed copper.

2.2 SUPPLEMENTAL BONDING NETWORKS.

Also known as Signal Reference Grids (SRGs), Mesh Bonding Networks (Mesh-BN), or Isolated Bonding Networks (IBNs), the requirements for supplemental bonding networks are not specified in this document. Supplemental bonding networks may not be used to replace a standards-compliant bonding infrastructure.

2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB).

The TBB bonds the facility Primary Bonding Busbar (PBB) to telecommunications space Secondary Bonding Busbars (SBBs).

A. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.

B. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and will be as straight as practicable avoiding bends.

C. Bonding the TBB to the PBB and each SBB will require a UL Listed irreversible compression (crimp) dual-lug connector.

2.4 BONDING CONDUCTORS.

A. Telecommunications Equipment Bonding Conductor (TEBC). The TEBC connects the cabinets and racks in the telecommunications space to the space’s bonding busbar (PBB or SBB).
   1. Material. Stranded copper wire with a green jacket (or per NEC depending on size), run as a continuous conductor.

2. Size. The TBB shall be sized to meet the requirements of ANSI/TIA-607-D. The minimum size for the TEBC shall be AWG 6.

3. Bonding. Bonded to the telecommunications space bonding busbar (PBB or SBB) via a UL Listed two-hole compression lug. Rack Bonding Conductors (RBCs) are connected to the TEBC using UL Listed irreversible compression (crimp) connectors.

B. Rack Bonding Conductor (RBC). The RBC is a bonding conductor from the cabinet or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).

1. Material. Stranded copper wire with a green jacket run as a continuous conductor.

2. Size. The minimum size for the RBC shall be AWG 6.

3. Bonding. Bonded to the Telecommunications Equipment Bonding Conductor (TEBC) using UL Listed irreversible compression (crimp) connectors.

a. Where connected to a server cabinet, the RBC extends to the bottom of the server cabinet allowing Equipment Bonding Conductors to be attached at any point in the cabinet.

b. Where connected to a network rack/cabinet, the Rack Bonding Conductor (RBC) is bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug.

C. Equipment/Unit Bonding Conductor (EBC/UBC). The Equipment/Unit Bonding Conductor connects individual equipment in a cabinet or rack to the Rack Bonding Conductor (RBC) or Rack Bonding Busbar (RBB). Equipment Bonding conductors are also used as cable tray bonding conductors to bond cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC).

1. Material. Stranded copper wire with a green jacket run as a continuous conductor.

2. Size. The minimum size for the RBC shall be AWG 6.

3. Bonding.

a. Where used in a server cabinet, bonded to the Rack Bonding Connector (RBC) using UL Listed irreversible compression (crimp) connectors and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

b. Where used in a network cabinet/rack, bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

c. Where used as a cable tray bonding conductor connecting cable tray sections, bonded to each adjoining section of the cable tray using UL Listed two-hole compression lugs.

d. Where used as a cable tray bonding conductor connecting cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC), bonded to the TEBC using UL Listed irreversible compression (crimp) connectors and to the cable tray via a UL Listed two-hole compression lug.

4. Contractor shall furnish a minimum of ten (10) EBCs for each RBB. Five (5) EBCs shall be outfitted as described here and shall be six (6) feet in length. Five (5) EBCs shall be outfitted as decried here and shall be nine (9) feet in length. Contractor shall use field measurements to determine EBC cable length when directed by VA project managers.

2.5 OVERVOLTAGE SURGE PROTECTORS.

A. Protectors are voltage-limiting devices intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents in communications lines caused by lightning, contacts with power conductors, power induction, and rises in ground potential.

1. Compliance. Protectors shall be compliant with UL 497 and/or UL 497A, as applicable.
2. Performance. Protectors shall be rated to support copper UTP performance Category 6A at 100MHz.
3. Protection. Voltage suppression shall be via low capacitance solid state protectors only, rated at 18V for copper backbone applications or 65V for VOIP or PoE applications.
4. Construction. Provide protection for each pair.
5. Termination shall be insulation-displacement contact.
6. Mounting. Protectors shall be wall-mounted.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

A. Components of the telecommunications bonding system will be installed and connected using materials and techniques required by ANSI/TIA-607-D. The use of antioxidant joint compound is required for all connections excluding protector 110 block connections.

B. Testing.

1. Perform tests per BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
2. Perform two-point bond test using trained installers qualified to use test equipment.
3. Conduct continuity tests to verify that metallic pathways in telecommunications spaces are bonded to PBB or SBB.

4. Conduct electrical continuity test to verify that PBB is effectively bonded to the facility grounding electrode conductor.
5. Perform resistance tests to ensure rack and cabinet bonding connection resistance measures less than 4Ω to PBB or SBB.

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SECTION 27 05 33
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies conduit, fittings, and boxes to form raceway systems for communications cabling. All conduit, fittings, and boxes to form raceway systems for communications cabling will be provided by the contractor.

1.2 RELATED WORK

A. Bedding of conduits: Section 31 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.

E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS, submit the following:

1. Size and location of cabinets, splice boxes, and pull boxes.
2. Layout of required conduit penetrations through structural elements.
3. Catalog cuts marked with specific item proposed and area of application identified.

B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Minimum Conduit Size: 19 mm (3/4 inch).

B. Conduit:

1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.
3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
4. Electrical Metallic Tubing (EMT):
   a. Maximum Size: 105 mm (4 inches).
   b. Install only for cable rated 600 volts or less.
   c. Conform to UL 797, ANSI C80.3.
5. Flexible Galvanized Steel Conduit: Conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
8. Surface Metal Raceway: Conform to UL 5.

C. Conduit Fittings:
1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
   a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
   b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
   c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
   e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
   f. Erickson (union-type) and Set Screw Type Couplings:
      1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
      2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground.
   g. Provide OEM approved fittings.

2. Rigid Aluminum Conduit Fittings:
    a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
    b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
    c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
    a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
    b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
        1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
        2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
        3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
    c. Indent type connectors or couplings are not permitted.
    d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
    e. Provide OEM approved fittings.
4. Flexible Steel Conduit Fittings:
    a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
    b. Provide clamp type, with insulated throat.
    c. Provide OEM approved fittings.
5. Liquid-tight Flexible Metal Conduit Fittings:
    a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
    b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
    c. Provide connectors with insulated throats to prevent damage to cable jacket.
    d. Provide OEM approved fittings.

6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
7. Expansion and Deflection Couplings:
    a. Conform to UL 467 and UL 514B.
    b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
    c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
    d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
8. Rigid Aluminum Fittings:
    a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
    b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
    c. Set Screw Fittings: Not permitted for use with aluminum conduit.
    d. Indent type connectors or couplings are prohibited.
    e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of “pot metal” are not permitted.
    f. Provide OEM approved fittings.

D. Conduit Supports:
1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Splice, and Pull Boxes:
1. Conform to UL-50 and UL-514A.
2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.

4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.

F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED COMMUNICATIONS CABLE BELOW”.

G. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway.
2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
5. Size: Metric Designator 53 (trade size 2) or smaller.
6. Outside Plant: Plenum-rated where each innerduct is 75 mm (3 inches) and larger.
7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
8. Plenum: Non-metallic communications raceway.
   a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
   b. UL 94 V-O rating for flame spreading limitation.
9. Provide innerduct reel lengths as necessary to ensure ducts are continuous.
10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.

H. Outlet Boxes:
1. Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
2. Flush wall mounted 12.7 cm (5 inches) square x 7.3 cm (2-7/8 inches); deep pressed galvanized steel.
3. 2-Gang Tile Box:

a. Flush backbox type for installation in block walls.

b. Minimum 92 mm (3-5/8 inches) deep.

I. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Penetrations:

1. Cutting or Holes:

a. Locate holes in advance of installation. Where proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.

b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.

c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

1) Fill and seal clearances between raceways and openings with fire stop material.

~~2)~~ Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.

~~3)~~2)

d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations: Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

B. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.

2. Install insulated bushings on all conduit ends.

3. Install pull boxes after every 180 degrees of bends (two 90-degree bends) or every 100ft. Size boxes per TIA 569.

4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a TR or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
9. Complete each entire conduit run installation before pulling in cables.
10. Flattened, dented, or deformed conduit is not permitted.
11. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
12. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
13. Install conduit mechanically continuous.
14. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
15. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
16. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
17. Conduit installations under fume and vent hoods are prohibited.
18. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
19. Do not use aluminum conduits in wet locations.
20. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
21. Conduit Bends:

a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.

b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.

c. Bending of conduits with a pipe tee or vise is not permitted.

d. Minimum radius of communication conduit bends:

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

22. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.

~~C.~~ Concealed Work Installation:

~~D.~~C.

1. In Concrete:

a. Conduit: Rigid steel or IMC.

b. Align and run conduit in direct lines.

c. Install conduit through concrete beams only when the following occurs:

1) Where shown on structural drawings.

2) As accepted by COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

d. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.

1) Conduit outside diameter larger than 1/3 of slab thickness is prohibited.

2) Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
3) Install conduits approximately in center of slab to ensure a minimum of 19 mm (3/4 inch) of concrete around conduits.

e. Make couplings and connections watertight. Use thread compounds that are NRTL listed conductive type to ensure low resistance ground continuity through conduits. Tightening set screws with pliers is not permitted.

~~E.~~D. Furred or Suspended Ceilings and in Walls:

1. Rigid steel, or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.
2. Align and run conduit parallel or perpendicular to building lines.
3. Tightening set screws with pliers is not permitted.

~~F.~~E. Exposed Work Installation:

1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
   a. Provide rigid steel, IMC or rigid aluminum.
   b. Different type of conduits mixed indiscriminately in system is not permitted.
2. Align and run conduit parallel or perpendicular to building lines.
3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
5. Painting:
   a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
   b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
   c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

~~G.~~F. Expansion Joints:

1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
3. Install expansion and deflection couplings where shown.

~~H.~~G. Seismic Areas:

1. In seismic areas, follow H-18-8 Seismic Design Requirements.
2. Rigidly secure conduit to building structure on opposite sides of a building expansion joint with pull boxes on both sides of joint.
3. Connect conduits to pull boxes with 375 mm (15 inches) of slack flexible conduit.
4. Install green copper wire minimum #6 AWG in flexible conduit for bonding jumper.

~~I.~~H. Conduit Supports, Installation:

1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
5. Fastenings and Supports in Solid Masonry and Concrete:
   a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
   b. Existing Construction:
      1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
      2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
      3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
6. Fastening to Hollow Masonry: Toggle bolts are permitted.
7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
8. Bolts supported only by plaster or gypsum wallboard are not acceptable.
9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

10. Do not support conduit from chain, wire, or perforated strap.
11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
12. Vertical Supports:
    a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
    b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

~~J.~~I. Box Installation:

1. Boxes for Concealed Conduits:
    a. Flush mounted.
    b. Provide raised covers for boxes to suit wall or ceiling, construction and finish. In spaces not controlled by VA (i.e., common hallways) covers must be lockable.
2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.
3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.

~~K.~~J. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:

1. Install Innerduct in cable tray. Innerduct may not be free-hung.
2. Install only in accessible spaces not subject to physical damage or corrosive influences.
3. Make bends manually to assure internal diameter of tubing is not effectively reduced.
4. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

3.2 TESTING

A. Examine fittings and locknuts for secureness.

B. Test RMC, IMC and EMT systems for electrical continuity and resistance to ground.

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SECTION 27 05 36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies requirements for telecommunications cabling cable tray and raceway equipment. All cable tray, raceway, and ladder rack for communications systems will be provided by contractor.

1.2 SUMMARY

Section Includes:

A. Cable Tray.

B. Fiber Optic Cable Raceway.

C. Ladder Rack.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Grounding and bonding: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 CABLE TRAY.

A. Design. Wire basket with tray insert. Maximum 2” x 4” wire mesh construction. Constructed of round, smooth wire with continuous top side to minimize cable sheath damage.

B. Finish. Coated to prevent rust.

C. Size. Cable tray shall be sized to hold the maximum expected cable load at not more than 40% fill and not more than 6” maximum cable depth.

D. Accessories. Provide and install the following components and accessories as necessary to achieve the design:

1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Tray section splicing hardware.

3. Tray insert.

4. Cable waterfalls.

5. Ground strap kits.

6. Bend radius limiters.

2.2 FIBER OPTIC CABLE RACEWAY.

A. Design. Raceway system shall be a modular system of channels, fittings, and brackets, able to be assembled with couplers. Fittings for cable spillout shall maintain a minimum 2” bend radius.

B. Materials. Raceway shall be constructed of rigid PVC and ABS plastics.

C. Size. Raceway shall be nominally sized 4”x4”.

D. Accessories. Provide and install the following components and accessories as necessary to achieve the design:

1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Hinged channel covers.

3. Raceway section couplers.

4. Channel corners and intersections.

5. Spillway fittings.

2.3 LADDER RACK.

A. Design. Ladder rack system shall be a modular system of ladder, turns, splices, supports, and accessories able to be assembled with couplers.

B. Finish. Coated to prevent rust.

C. Materials. Ladder rack shall be manufactured from tubular steel and extruded aluminum. Stringers will be 3/8” by 1-1/2” tubular teel. Cross members will be 1” x 1/2" T-shaped. Steel elements shall have a minimum 0.065” wall thickness.

D. Size. Ladder rack shall be nominally sized 12” width.

E. Accessories. Provide and install the following components and accessories as necessary to achieve the design:

1. Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements.

2. Ladder rack section couplers (splices).

3. Ladder rack radius bends.

4. Ground strap kits.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. Cable tray shall be used in horizontal applications. Ladder rack is used in vertical applications.

B. Cable tray and ladder rack sections shall be bonded together with bonding conductors and the system bonded to the bonding busbar in the space.

C. Support horizontal cable tray not less than every 5’ (shorter spans if recommended by the equipment manufacturer).

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SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies labeling and identification requirements for information technology (IT) equipment cabinets, racks, and cabling. All labelling and associated labelling hardware will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Equipment and component labels.

B. Labeling implementation requirements.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.

C. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

D. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND COMPONENT LABELS.

A. Materials. Materials used for labeling equipment, components, and telecommunications cabling shall be appropriate for the installation environment, durable and permanent, and heat-resistant if necessary for labeling in high-temperature environments.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. Governing Standard. Labeling and identification of equipment, components, and telecommunications cabling shall be based on ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure, and NFPA 70, National Electrical Code, as modified by guidance in the VA Infrastructure Standard for Telecommunications Spaces.

B. All passive infrastructure equipment, components, and telecommunications cabling installed shall be labeled at the time of installation.

C. Telecommunications cable labeling shall include delivery of complete and accurate connection documentation (where each cable terminates at each end) matching the installed labels.

D. Label locations shall be as specified in the VA Infrastructure Standard for Telecommunications Spaces.

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SECTION 27 10 00
STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies requirements for telecommunications structured cabling systems. All backbone and horizontal cabling and associated hardware will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Computer Room Backbone Structured Cabling.

B. Computer Room Horizontal Structured Cabling.

C. Facility Backbone Structured Cabling.

D. Facility Horizontal Structured Cabling.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Cabling labeling and identification: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

B. Cable termination locations and equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

PART 2 - PRODUCTS

2.1 COMPUTER ROOM BACKBONE STRUCTURED CABLING.

Backbone structured cabling in the computer room environment (first level backbone) connects the Main Distribution Areas (MDAs) to the Horizontal Distribution Areas (HDAs).

A. Install first level backbone structured cabling in overhead or underfloor cable tray and fiber raceway systems following diverse path routing.

B. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

C. Terminate first level backbone structured cabling in the top RU positions of each network rack or cabinet, working downward, with patch panel equipment mounted on the front rails.

D. Mirror distribution on the A-side and B-side MDA and HDA elements.

1. In MDA network cabinets:

a. Install angled UTP patch panel(s) for each backbone UTP patch panel in the same-side HDA in the computer room beginning in RU45.
b. Install an angled panel cover on the lowest UTP patch panel.
c. Install a blanking panel in the RU below the UTP patch panels.
d. Install fiber optic distribution cabinets to support the backbone fiber distribution from each HDA.
e. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).

2. In HDA network cabinets:
   a. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes starting in RU45.
   b. Install a blanking panel in the RU below the last fiber cabinet.
   c. Install UTP patch panel(s) below the blanking panel.
   d. Install a blanking panel in the RU below the last UTP patch panel.

E. Install UTP cables between the same-side MDAs and HDAs.
F. Install 12- or 24-strand multimode fiber optic cables between each fiber cassette in the HDA to either the same-side MDA or the opposite side MDA as appropriate.

2.2 COMPUTER ROOM HORIZONTAL STRUCTURED CABLING.

Horizontal structured cabling in the computer room environment connects the Equipment Distributors (EDs) in the server cabinets to each supported Horizontal Distribution Area (HDA).

A. Install horizontal structured cabling in overhead cable tray and fiber raceway systems following diverse path routing.
B. All cabling used shall be pre-terminated and procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.
C. In the server cabinets, terminate horizontal structured cabling in EDs located in the top 5U of each cabinet, with patch panel equipment mounted on the rear rails.
   1. Install fiber optic distribution cabinet(s) starting in RU45 and populate with fiber optic distribution cassettes to support the requirement.
   2. Install a blanking panel in the RU below the last fiber cabinet.
   3. Install copper UTP patch panel(s) below the blanking panel.

D. In the HDAs, terminate horizontal structured cabling in the RU positions immediately below the first level backbone structured cabling equipment of each network cabinet, working downward, with patch panel equipment mounted on the front rails.
    1. Install fiber optic distribution cabinet(s) and populate with fiber optic distribution cassettes to support each server cabinet.
    2. Install a blanking panel in the RU below the fiber optic distribution cabinet(s).
E. Install 12- or 24-strand multimode fiber optic cables between the server cabinet ED and both HDAs.
F. Install UTP cables between the server cabinet ED and both HDAs.

2.3 FACILITY BACKBONE STRUCTURED CABLING.

Backbone structured cabling (inter-building and intra-building first level backbone) connects the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room and connects the Main Distribution Areas to each Telecommunications Room (TR). This specification describes facility backbone structured cabling when the Entrance Rooms and computer room are in the same building, connected entirely by environmentally conditioned pathways (no outside plant pathways are transited).

A. Interior to each telecommunications space, install facility backbone structured cabling in overhead cable tray and fiber raceway systems.
B. All facility backbone structured cabling shall be redundant and follow diverse path routing.
C. Facility backbone cabling shall be field-terminated (fusion spliced).
D. In the Entrance Room, MDA, and TR network racks AND cabinets designated for facility backbone distribution, install fiber optic distribution cabinets as required for the quantity of fibers installed.
E. Between each Entrance Room and the computer room:
    1. Provide 2 diversely routed paths of backbone cabling from each Entrance Room. One path will terminate on the A-side MDA and one path will terminate on the B-side MDA.
    2. Install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
    3. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.
F. Between each MDA and each TR:

1. No zone/intermediate distribution areas (ZDAs/IDAs) intermediate cross-connects (ICCs) shall be used. All facility backbone cabling between the MDAs and TRs shall be run directly and continuously.
2. Provide 2 diversely routed paths of backbone cabling, one from the A-side MDA and one from the B-side MDA.
3. Where the TR is located in the same building as the computer room MDAs (does not transit outside plant pathways) and the path distance is less than 400 meters, install a minimum of 24 strands of multimode fiber optic cabling and 12 strands of single-mode fiber optic cabling per path.
    a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of multimode OM4 and single-mode OS1 fiber optic splice cassettes per path.
4. Where the TR is located in a different building as the computer room (transits outside plant pathways) or the path distance is greater than 400m, install a minimum of 24 strands of single-mode fiber optic cabling per path.
    a. Populate the fiber optic distribution cabinets on each end with a sufficient quantity of single-mode OS2 fiber optic splice cassettes per path.

2.4 FACILITY HORIZONTAL STRUCTURED CABLING.

Facility horizontal structured cabling (horizontal distribution) connects the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO).

A. Interior to each TR, install horizontal distribution structured cabling in overhead cable tray systems.
B. All horizontal distribution structured cabling shall have a minimum of 2 cables per WAO.
C. Horizontal distribution structured cabling may be field-terminated.
D. In each TR install sufficient UTP patch panels to support the quantity of WAOs in the TR's serving zone.
    1. Plan network racks such that patch panels and horizontal cable managers are located in the top 1/3 (RU31-45), switching equipment in the middle 1/3 (RU16-30), and power distribution and other services in the bottom 1/3 (RU1-15).
E. Install a minimum of 2 UTP cables between the TR UTP patch panels and each work area faceplate.

F. Each typical end-user receptacle shall be constructed of a single-gang workbox with one connector chassis, a minimum of two non-proprietary Category 6A 8P8C media interface connectors (RJ-45), and a four-position keystone faceplate.
    1. Modular plug terminated links (MPTL) are permitted to service wireless access points (WAPs), cameras, and other Power over Ethernet (PoE) devices where mating will be very infrequent.

PART 3 - EXECUTION

3.1 IMPLEMENTION:

A. 100% construction drawing sets shall include drawings detailing the computer room and facility/campus structured cabling systems, including:
    1. Cable media performance categories for each type of run.
    2. Cabling and equipment quantities.
    3. Elevation drawings showing equipment placement in individual enclosures.
    4. Full interconnection diagram for all structured cabling.
    5. Port map and cable label matrices.

B. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

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SECTION 27 11 16
COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies Information Technology (IT) equipment enclosures for use in VA telecommunications spaces. All cabinets, racks, and enclosures will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Server Cabinets.

B. Network Channel Racks.

C. Network Cabinets.

D. Telecommunications Enclosures.

E. Pathway Racks.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Cabling termination equipment, rack-mounted: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable management equipment: Section 27 05 36, CABLE TRAYS FOR COMMUNICATIONS SYSTEMS.

C. Power distribution equipment: Section 27 11 26, COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS.

D. Grounding and bonding equipment: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

E. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

F. Seismic bracing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 SERVER CABINETS.

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 84” (2134mm) tall, 23.6” (600mm) wide, and 48” (1220mm) deep, including side panels and doors. Minimum depth is 46” (1168mm). Maximum width is 30”.

C. Doors and Panels.

1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.

2. Rear Door. Provide a single locking, latched, hinged metal rear door for the server cabinet.

a. If a vertical exhaust duct (VED, “chimney”) is specified for the server cabinet, the rear door shall be solid.

b. If no VED is specified, the rear door shall be perforated with a minimum of 75% open design for airflow.

3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting. *Front and rear rack rails shall be installed a minimum of 3 inches from the front edge of the cabinets allowing the doors to close completely after the server equipment has been installed.*

NOTE: Rack Rails are for equipment mounting only. Rack Rails shall not be used to support cables, power cords or tie wraps.

1. Rear Rails. Position rear rails with a minimum of 6” of clearance between the rails and the rear doors to accommodate rear-mounted angled patch panels and up to four (4) vertical rack PDUs.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. Air dams for left and right of the front rails.

b. Finger cable managers.

c. Bottom panel with brushed grommets.

d. Top panel with brushed grommets.

e. Toolless mounting brackets for vertical Rack PDUs.

f. 45U of 1RU blanking panels.

2.2 NETWORK CHANNEL RACKS.

A. Height. Racks shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for network racks are 86” (2184mm) tall, 24” (610mm) wide, and 40” (1220mm) deep (30”/762mm between front and rear mounting rails).

C. Side Panels. The rack shall have integral metal side panels (a “channel” rack) constructed with a cable management pattern of staggered shapes (circles, hexagons, etc.) to allow for connection points for cable management accessories.

D. Security Doors. Provide locking, latched, hinged metal doors and mounting hardware for the network rack. Doors shall be perforated with a minimum of 50% open design for airflow.

1. Locks. All locks on a network rack shall be keyed the same. Provide two keys per cabinet.

E. Color. The rack and all components shall be white in color.

F. Equipment Mounting Rack. The rack shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting EIA-tapped 10-32 holes. *Front and rear rack rails shall be installed a minimum of 3 inches from the front edge and rear edge of the cabinets allowing the doors to close completely after the server equipment has been installed.*

G. Components. The rack shall be supplied with the following standard equipment:

a. Toolless mounting brackets for vertical Rack PDUs.

b. 30U of 1RU blanking panels.

c. Vertical cable managers with doors on both left and right of the rack (size commensurate with the requirement).

d. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

2.3 NETWORK CABINETS.

A. Height. Cabinets shall provide 45 standard rack units (RU) of space (45U) for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 84” (2134mm) tall, 31.5” (800mm) wide, and 48” (1220mm) deep, including side panels and doors. Minimum depth is 46” (1168mm). Maximum width is 24” (610mm).

C. Doors and Panels.

1. Front Door. Provide a single locking, latched, hinged metal front door for the server cabinet with minimum 75% open perforated design for airflow.

2. Rear Door. Provide a single locking, latched, hinged metal rear door for the server cabinet.

a. If a vertical exhaust duct (VED, “chimney”) is specified for the server cabinet, the rear door shall be solid.

b. If no VED is specified, the rear door shall be perforated with a minimum of 75% open design for airflow.

3. Side Panels. Provide removable, locking solid metal side panels. Side panels shall have cable pass-through cut-outs protected with brushed grommets on each side, aligned on each side to allow Rack PDU and communications cables to pass between enclosures to Zone PDUs.

D. Locks. All locks on a server cabinet shall be keyed the same. Provide two keys per cabinet.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard 3/8” x 3/8” square hole mounting.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. Air dams for left and right of the front rails.

b. Bottom panel with brushed grommets.

c. Top panel with brushed grommets.

d. Toolless mounting brackets for vertical Rack PDUs.

e. 45U of 1RU blanking panels.

f. Cable management accessories as necessary to maintain cable bend radii, uniformity, and neatness (e.g. d-rings, spools, bend radius limiters, finger cable managers, waterfalls, etc.).

2.4 TELECOMMUNICATIONS ENCLOSURES (TE).

Telecommunications Enclosures (TEs) are swing-out wall-mounted enclosures.

A. Height. TEs shall provide 26 other standard rack units (RU) of space for mounting equipment.

B. Dimensions. Nominal dimensions for server cabinets are 24” (610mm) 48” (1220mm) other tall, 24” (610mm) wide, and 30” (760mm) deep.

C. Doors and Panels.

1. Front Door. TEs shall have a single locking, latched, hinged metal front door with a tempered glass front.

2. Rear Panel. TEs shall have a latched, hinged metal rear door that mounts to the wall, allowing the body of the TE to be swung open for rear equipment access. If latched exterior to the body of the TE, the latch shall be locking.

a. Cabling Cutouts. The top and bottom surfaces of the rear panel shall have cabling cutouts to accommodate telecommunications cabling entering the TE. Edge-protection grommets for the cabling cutouts shall be provided.

b. Power Cutout. The rear panel shall have a cutout on the rear mounting surface allowing power to be installed internal to the TE.

3. Locks. All locks on a TE shall be keyed the same. Provide two keys per TE.

D. Load Rating. The TE shall support 300lb (136kg) of total weight.

E. Color. The cabinet and all components shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with front and rear rails using standard threaded #12-24 hole mounting.

G. Components. The cabinet shall be supplied with the following standard equipment:

a. 1U shelf (two per TE).

b. Vertical cable management kits (one per each full 12U of TE height).

c. Fan kit to evacuate heat generated by active equipment (two per TE).

d. Filter kit for fans (two per TE).

e. Tamper switches on front and rear doors. Tamper switches shall be connected to the existing Access Control system.

2.5 PATHWAY RACKS.

A. Height. Pathway racks shall provide a minimum of 5 standard rack units (RU) of space (5U) for mounting Equipment Distributor equipment.

B. Dimensions. Nominal dimensions for pathway racks are 12.6” tall, 23.6” wide, and 9” deep.

C. Mounting. Pathway racks shall mount to standard basket-style cable tray.

E. Color. Pathway racks shall be white in color.

F. Equipment Mounting Rack. The cabinet shall provide an EIA-310-E compliant 19” racking system with rails using standard 3/8” x 3/8” square hole mounting EIA-tapped 10-32 holes.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Where to be installed in structures assigned to Seismic Design Category C, D, E, or F, seismic bracing equivalent to that for other storage racks per VA Master Specification 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS section 3.7 (“Install… to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements”) is required.

B. Casters on floor-mounted enclosures shall be retracted and the enclosures leveled and stabilized.

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SECTION 27 11 19
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies cable termination and management equipment to be mounted in information technology (IT) equipment cabinets and racks. All cable terminations, equipment management to include patch panels, fiber cabinets, fiber cassettes, splice cassettes, cable managers, and blanking panels will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Copper UTP Patch Panels.

B. Fiber Optic Distribution Cabinets.

C. Fiber Optic Distribution Cassettes.

D. Fiber Optic Splice Cassettes.

E. Horizontal Cable Managers.

F. Blanking Panels.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Server cabinets and network racks: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES.

B. Cable management equipment: Section 27 11 23, COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK.

C. Labeling and identification requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

D. Copper UTP cabling: Section 27 13 13, COMMUNICATIONS COPPER BACKBONE CABLING.

E. Copper UTP cabling termination: Section 27 13 13.13, COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS.

F. Fiber optic cabling: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

G. Fiber optic cabling termination: Section 27 13 23.13, COMMUNICATIONS OPTICAL FIBER SPLICING AND TERMINATIONS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) PATCH PANELS.

A. Form Factor. 1U, 19” rack-mountable. Default form factor for patch panels shall be angled to extend not less than 4” (104mm) forward from the mounting rail.

B. Capacity. 48 copper 8P8C ports in groupings of 6.

C. Interface. Copper (UTP) patch panels shall accept pre-terminated single 8P8C keystone jacks and 6-jack cassettes.

D. Accessories. Provide each patch panel installation with the following accessories.

1. Angled panel cover. Specify angled panel covers at the top and bottom of each stack of angled patch panels. Covers shall mount to the same RU rail positions as the top and bottom patch panels.

2. Rear cable manager tray. Specify one rear cable manager tray per patch panel. Trays shall mount to the same RU rail positions as the patch panel.

2.2 FIBER OPTIC DISTRIBUTION CABINETS.

A. Form Factor. 1U, 19” rack-mountable, angled to extend not less than 4” (104mm) forward from the mounting rail.

B. Capacity. 144 fibers in a variety of distribution and/or splice cassettes.

C. Door. Cabinets shall be supplied with a locking front cover.

D. Accessories. Provide each distribution cabinet with the following accessories.

1. Rear cable manager. Specify one rear cable manager with fiber storage rings per distribution cabinet. Trays shall mount to the same RU rail positions as the distribution cabinet.

2. 0RU patch cord managers. Specify one pair of patch cord managers per distribution cabinet. Managers shall mount to the same RU rail positions as the distribution cabinet and rear cable manager.

2.3 FIBER OPTIC DISTRIBUTION CASSETTES.

Fiber optic distribution cassettes are used in structured cabling in the computer room to connect Main Distribution Areas (MDAs), Horizontal Distribution Areas (HDAs), and Equipment Distributors (EDs) where pre-terminated cable is used.

A. Form Factor. Designed to install in rack-mounted fiber optic distribution cabinet.

B. Connections. The rear connection shall accept 12-strand multi-fiber push-on (MPO) connectors AND 24-strand multi-fiber push-on (MPO) connectors. Adapters on the front of the cassette shall accept 6 duplex Lucent connector (LC) fiber pairs 3 sets of 8-strand multi-fiber push-on (MPO) connectors.

C. Polarity. Provide type A & B universal cassettes.

2.4 FIBER OPTIC SPLICE CASSETTES.

Fiber optic splice cassettes are used in backbone structured cabling connecting the Entrance Rooms to the Main Distribution Areas (MDAs) in the computer room, and the MDAs to Telecommunications Rooms (TRs) where field-terminated (fusion spliced) cable is used.

A. Form Factor. Designed to install in rack-mounted fiber optic distribution cabinet.

B. Connections. Adapters on the front of the cassette shall accept 6 duplex Lucent connector (LC) fiber pairs OR 3 sets of 8-strand multi-fiber push-on (MPO) connectors.

C. Design. Splice cassette modules shall be self-contained to integrate fiber adapter bulkhead and splice holders. No additional splice trays shall be necessary. Each module shall provide 12 AND/OR 24 fiber splice connections.

D. Fiber Type. Provide multimode OM4 and single-mode OS2 splice cassettes as required by the quantity of each type of fiber installed.

2.5 HORIZONTAL CABLE MANAGERS.

A. Form Factor. 2U, 19” rack-mountable.

B. Door. Horizontal cable managers shall have a double-hinged front cover to protect installed cables.

2.6 BLANKING PANELS.

A. Form Factor. 2U, 19” rack-mountable, angled to extend 4” (104mm) forward from the mounting rail.

B. Transition. Blanking panel shall have a transition cover from angled front to flat front.

C. Quantity. Provide blanking panels to fill 75% of all RUs in all server cabinets and network cabinets

PART 3 - EXECUTION

3.1 INSTALLATION:

Not used.

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SECTION 27 11 26
COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies power distribution equipment and interconnections supporting equipment deployed in telecommunications spaces (entrance rooms, computer rooms, and telecommunications rooms). All power distribution and interconnections supporting equipment will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Zone Power Distribution Units (zPDUs).

B. Rack-Mounted Uninterruptible Power Supply (UPS) Units.

C. Rack Power Distribution Units (rPDUs).

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK

A. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. IT equipment enclosures: Section 27 11 16, COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

1.5 SUBMITTALS

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

B. For each type of product:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for rack-mounted power protection and power strips.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 ZONE POWER DISTRIBUTION UNITS (ZONE PDU)

A. Provide components from a single manufacturer.

B. 60 Amp Zone PDU:

1. Description: Zone PDU with A/B redundant 3-phase 60A input circuits and three (3) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at full density rating.

2. Input Connection: Dual 60A three-phase 208V hard-wired, with junction box and five-wire (L+L+L+N+G) DIN copper terminal blocks accommodating 4AWG conductors. Power cord 10’ (3m) length.

3. Output Connection: Three (3) pairs of A/B (redundant) L21-20R outlets.

4. Power Capacity: 43.2kW (21.6kW redundant at full load); 5.7kW fully-rated at each L21-20R outlet.

5. Enclosure: Fully self-contained.

6. Mounting: 1” rack-mount.

C. 30 Amp Zone PDU:

1. Description: Zone PDU with A/B redundant 3-phase 30A input circuits and two (2) pairs of A/B redundant L21-20R outlets allowing each supported Standard Density (5kW) enclosure to operate at partial density rating.

2. Input Connection: Dual 30A three-phase 208V L21-30P. Power cord 10’ (3m) length.

3. Output Connection: Two (2) pairs of A/B (redundant) L21-20P outlets.

4. Power Capacity: 21.6kW (10.8kW redundant at full load); combined 8.6kW rated output through each A/B pair of L21-20R outlets.

5. Enclosure: Fully self-contained.

6. Mounting: 1” rack-mount.

2.2 RACK-MOUNTED UNINTERRUPTIBLE POWER SUPPLY (UPS) UNITS

A. Provide components from a single manufacturer.

B. Description: 5kW three-phase 208V 20A rack-mounted UPS with L21-20 input and output connections.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord minimum 3’ (1m) length.

D. Output Connection: Single output NEMA L21-20R receptacle.

E. Power Capacity: 5kW

F. Enclosure: Fully self-contained.

G. Mounting: 19” rack mount.

H. Battery Capacity: Ten minutes at 70% load (3.5kW).

I. Cooling: Fan-cooled, front air entry, rear exhaust.

2.3 RACK POWER DISTRIBUTION UNITS (RACK PDUS)

A. Provide components from a single manufacturer.

B. Description: Metered/monitored three-phase 208V 20A vertical Rack Power Distribution Unit (Rack PDU), 5.7kW, with IEC60320 outlets.

C. Input Connection: Single input NEMA L21-20P plug (twistlock three-phase five wire L+L+L+N+G). Power cord 10’ (3m) length.

1. For Computer Room applications: Minimum 30 each C13 and 6 each C19. Outlets grouped in phase-grouping banks (A-B, B-C, C-A) or alternating to assist with phase balancing. Outlets labelled with associated phase-grouping bank.

2. For Telecommunications Room (TR) and entrance room applications: Minimum 30 each C13, 6 each C19, 2 each L5-20. Outlets grouped in phase-grouping banks (A-B, B-C, C-A) or alternating to assist with phase balancing. Outlets labelled with associated phase-grouping bank.

E. Power Capacity: 5.7kW rated.

F. Enclosure: Fully self-contained.

G. Mounting: Toolless mounting, orientation vertical at rear of enclosure, taking up zero RU spaces. Up to two Rack PDUs must be able to be installed on each side for High Density (10kW) enclosures.

H. Mounting Hardware: As required to connect to the specific enclosure make/model.

I. Number of RPDUs: 2 for Standard Density (up to 5kW) enclosures, 4 for High Density (10kW) enclosures.

J. Metering: Local display provides input line currents (Amperage). Additional metering items (voltage, power, energy, power factor) across the unit or at individual outlets, is acceptable.

K. Monitoring: RJ45 Ethernet port allows connection to an external monitoring system. Supports SNMP v3 with SSL Encryption.

PART 3 - EXECUTION

3.1 INSTALLATION

A. DEFINITION: Sides (left/right) of the enclosure are as when viewed from the rear (hot aisle) of the enclosure for the purposes of this section.

B. Zone PDUs.

1. Install Zone PDUs only in enclosures that require them.
2. Zone PDUs shall not be installed in enclosures supported by busbar power distribution.
3. Install Zone PDUs beginning in RU position 1 or the first open RU position above any rack-mounted UPS unit, at the bottom of the 19” rack, on the rear rails of the enclosure.
4. Connect the Zone PDU power cords to the upstream branch circuit supporting the enclosures.

C. Rack-Mounted UPS Units.

1. Install rack-mounted UPS units only in enclosures that require them. Rack-mounted UPS units shall not be installed downstream of another UPS system (cascaded).
2. Where non-redundant UPS power is required to support the enclosure, install the rack-mounted UPS unit in the A side power distribution.
3. Install rack-mounted UPS units beginning in RU position 1, at the bottom of the 19” rack, with the exhaust ports facing the rear of the enclosure. No other equipment should be installed below the rack-mounted UPS units.
4. Connect the rack-mounted UPS unit power cord to the appropriate (A side) power receptacle on the upstream Zone PDU.

D. Rack PDUs.

1. Install Rack PDUs in matched A/B pairs only.
2. Install A side Rack PDUs on the left side of the enclosure and B side Rack PDUs on the right side of the enclosure, interior to the rear enclosure door.
3. Connect the Rack PDU power cord to the upstream rack-mounted UPS unit (where present) or the appropriate power receptacle on the upstream Zone PDU.

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SECTION 27 13 23
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies requirements for telecommunications optical fiber backbone cabling. All fiber optical backbone cable and associated hardware to include multimode, single mode, and Hybrid cables will be provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Multimode Optical Fiber Backbone Cables.

B. Single Mode Optical Fiber Backbone Cables.

C. Hybrid Optical Fiber Backbone Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

1.5 SUBMITTALS:

A. Submit in accordance with Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 MULTIMODE OPTICAL FIBER BACKBONE CABLES.

Multimode fiber optic backbone cables are specified for inside plant use, for data center backbone use as well as for intrabuilding campus backbone.

A. Performance Category. Laser-optimized OM4 or OM5 cables are specified.

B. Testing. All fiber optic backbone media shall pass all Tier 1 requirements (attenuation with an Optical Loss Test Set or OLTS, verification of cable length and polarity) and all Tier 2 requirements

(characterization by an Optical Time Domain Reflectometer or OTDR resulting in indication of the uniformity of cable attenuation and connector insertion loss).

C. Termination. For computer room first level backbone usage, factory pre-terminated cables with MPO connectors are required. Fiber will be field terminated (fusion spliced) when used to connect the computer room to Telecommunications Rooms (TRs) and other telecommunications spaces.

1. Polarity. For pre-terminated MPO-MPO cables, the polarity of the cables shall be matched to the type of fiber optic distribution cassettes specified.

D. Jacket Color.

1. OM4. Aqua.

2. OM5. Lime.

E. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

F. Bundling and Construction. Bundles consisting of multiples of sub-bundles (subunits) of 12 strands of fiber are specified. Cables shall be dielectric and tight-buffered. Construction shall match the rear entry requirements of the fiber optic distribution or splice cassette such that the sub-bundle (subunit) remains jacketed into the cassette.

G. Length. Backbone cabling for computer room first level backbone use (pre-terminated) shall be procured to the specific length required by the design (horizontal and vertical paths) with no more than 1 meter of excess length on each end.

2.2 SINGLE MODE OPTICAL FIBER BACKBONE CABLES.

Single mode fiber optic backbone cables are specified for inside and outside plant use, for campus backbone (interbuilding and intrabuilding) use.

A. Performance Category. OS1 is specified for inside plant applications. Inside/outside rated OS2 is specified for applications where the pathway transits an outside plant path.

B. Testing. All fiber optic backbone media shall pass all Tier 1 requirements (attenuation with an Optical Loss Test Set or OLTS, verification of cable length and polarity) and all Tier 2 requirements (characterization by an Optical Time Domain Reflectometer or OTDR resulting in indication of the uniformity of cable attenuation and connector insertion loss).

C. Termination. Fiber will be field terminated (fusion spliced) when used to connect the computer room to Telecommunications Rooms (TRs) and other telecommunications spaces.

D. Jacket Color. Yellow.

E. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

F. Bundling and Construction. Bundles consisting of multiples of sub-bundles (subunits) of 12 strands of fiber are specified. Cables shall be dielectric and tight-buffered for OS1, and loose-tube gel-filled for OS2.

2.3 HYBRID OPTICAL FIBER BACKBONE CABLES.

Hybrid cables containing multiple 24-strand bundles (subunits) of multimode and/or single mode fiber are acceptable.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Interior to telecommunications spaces, install fiber optic backbone cabling in overhead cable tray and fiber raceway systems.

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SECTION 27 13 23.13
COMMUNICATIONS OPTICAL FIBER SPLICING AND TERMINATIONS

PART 1 – GENERAL

1.1 DESCRIPTION:

This section specifies requirements for terminations of fiber optic cabling. All fiber terminations and associated hardware will be verified and provided by the contractor.

1.2 SUMMARY

Section Includes:

A. Termination Requirements.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Fiber optic cabling requirements: Section 27 13 23, COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TERMINATION REQUIREMENTS.

A. Terminate fiber optic cabling with duplex Lucent connector (LC) adapters AND 12-fiber multi-fiber push on (MPO) connectors 24-fiber multi-fiber push on (MPO) connectors as required for the application.

B. Pre-terminated connections are preferred for computer room structured cabling applications. Field termination (fusion splicing) for non-computer room applications where cable lengths cannot be determined in advance is acceptable.

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SECTION 27 15 13
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies requirements for telecommunications copper (UTP) horizontal distribution cabling outside of the computer room. For copper (UTP) horizontal cabling in structured cabling systems in the computer room, see Section 27 13 13 Communications Copper Backbone Cabling. All horizontal copper cables and associated hardware will be supplied by the contractor.

1.2 SUMMARY

Section Includes:

A. Copper (UTP) Horizontal Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Computer room structured cabling: Section 27 10 00, STRUCTURED CABLING.

B. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) HORIZONTAL CABLES.

Copper (UTP) horizontal cables connect the Telecommunications Room (TR) to each end-user Work Area Outlet (WAO) (horizontal distribution).

A. Performance Category. Copper (UTP) horizontal cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

B. Performance Specifications. Meets or exceeds TIA-EIA-568-C.2-10 and TSB-155.

C. Limited Power (LP) Certification. UL Listed as x-LP (0.5A).

D. Termination. Field terminated TIA 568B.

E. Testing. Following installation, each cable shall be field certified to meet performance category requirements per TIA 568-C.2.

F. Conductor Size. 22-24AWG.

G. Jacket Rating. Communications Multipurpose Cable, Plenum (CMP) shall be specified if any portion of the cable passes through an NEC-defined plenum. Communications Multipurpose Cable, Riser (CMR) shall be specified for all other applications. CMP may be used as a substitute for CMR.

H. Construction. Copper Clad Aluminum (CCA) cable is not permitted.

J. Length. The maximum distance for UTP horizontal cables is limited to 295 feet.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. A. All cabling and equipment shall be labeled per the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

B. Interior to the TR, install horizontal copper (UTP) structured cabling in overhead cable tray.

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SECTION 27 16 19
COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS CONNECT WIRE

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies requirements for telecommunications patch cords. The contractor will supply all patch cords, station cords, and cross connect wire.

1.2 SUMMARY

Section Includes:

A. Copper (UTP) Patch Cables.

B. Fiber Optic Patch Cables.

1.3 REFERENCES

A. VA Infrastructure Standard for Telecommunications Spaces.

1.4 RELATED WORK:

A. Termination equipment: Section 27 11 19, COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS.

B. Cable labeling requirements: Section 27 05 53, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS.

PART 2 - PRODUCTS

2.1 COPPER (UTP) PATCH CABLES.

A. Performance Category. Patch cables shall meet the Category 6A performance requirements. Category 6A connectors are required.

B. Termination Method. Factory pre-terminated TIA 568B.

C. Conductor Size. 22-28AWG. Where 28AWG patch cords are specified, the overall horizontal channel distance is reduced.

D. Length. Patch cords of the shortest appropriate length shall be used.

2.2 FIBER OPTIC PATCH CABLES.

A. Construction. Fiber patch cords shall be constructed of pairs (2-strands) of multimode laser-enhanced 50/125µm AND single mode laser-optimized 9/125µm fiber.

B. Performance Category. Multimode patch cords shall meet the OM4 performance requirements.

C. Connectors. Duplex Lucent connector (LC) connectors are required. Where polarity requirements are not known, reversible polarity duplex LC connectors are specified on one end.

D. Termination Method. Factory pre-terminated.

E. Length. Patch cords of the shortest appropriate length shall be used.

PART 3 - EXECUTION

3.1 IMPLEMENTATION.

A. Patch cords shall not be used to connect equipment in different server cabinets.

B. Patch cords shall be neatly installed using cable management equipment and following cable management principles.

C. Upon installation patch cords shall be labeled in accordance with the requirements of the VA Infrastructure Standard for Telecommunications Spaces.

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SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.

B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.

C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.

D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of

equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:
   1. Description of Work for Electronic Security Systems,
   2. Electronic security equipment coordination with relating Divisions,
   3. Submittal Requirements for Electronic Security,
   4. Miscellaneous Supporting equipment and materials for Electronic Security,
   5. Electronic security installation requirements.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 08 11 73 - SLIDING METAL FIRE DOORS. Requirements for door installation.

D. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.

E. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.

F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.

G. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

H. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

I. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

J. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

K. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.

L. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.

M. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.

N. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.3 DEFINITIONS

A. AGC: Automatic Gain Control.

B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. BICSI: Building Industry Consulting Service International.

D. CCD: Charge-coupled device.

E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.

F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

H. CPU: Central processing unit.

I. Credential: Data assigned to an entity and used to identify that entity.

J. DGP: Data Gathering Panel – component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.

K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.

L. EMI: Electromagnetic interference.

M. EMT: Electric Metallic Tubing.

N. ESS: Electronic Security System.

O. File Server: A PC in a network that stores the programs and data files shared by users.

P. GFI: Ground fault interrupter.

Q. IDC: Insulation displacement connector.

R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

S. I/O: Input/Output.

T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

V. LAN: Local area network.

W. LCD: Liquid-crystal display.

X. LED: Light-emitting diode.

Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

AA. M-JPEG: Motion – Joint Photographic Experts Group.

BB. MPEG: Moving picture experts group.

CC. NEC: National Electric Code

DD. NEMA: National Electrical Manufacturers Association

EE. NFPA: National Fire Protection Association

FF. NTSC: National Television System Committee.

GG. NRTL: Nationally Recognized Testing Laboratory.

HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. RCDD: Registered Communications Distribution Designer.

NN. RFI: Radio-frequency interference.

OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

QQ. RS-485: An TIA/EIA standard for multipoint communications.

RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

VV. UPS: Uninterruptible Power Supply

WW. UTP: Unshielded Twisted Pair

XX. Workstation: A PC with software that is configured for specific limited security system functions.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within [60] <insert number> miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall

provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 GENERAL ARANGEMENT OF CONTRACT DOCUMENTS

A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.

B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".

2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

D. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer’s information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.

5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
   a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
      1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
      2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
   b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
   c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
   d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
   e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.

1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16” tall.

f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
   2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
   3) The manuals shall include:
      a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
      b) A control sequence describing start-up, operation, and shutdown.
      c) Description of the function of each principal item of equipment.
      d) Installation and maintenance instructions.
      e) Safety precautions.
      f) Diagrams and illustrations.
      g) Testing methods.
      h) Performance data.

i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.

j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.

h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.

i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.

k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

n. Calculations: Provide a section for circuit and panel calculations.

o. Loading Sheets: Provide a section for DGP Loading Sheets.

p. Certifications: Provide section for Contractor's manufacturer certifications.

7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.

9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:
   a. General – Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings.
   b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
   c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
   d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      1) Security devices by symbol,
      2) The associated device point number (derived from the loading sheets),
      3) Wire & cable types and counts
      4) Conduit sizing and routing
      5) Conduit riser systems
      6) Device and area detail call outs
   e. Architectural details – Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,
   f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
   g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.

h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

i. Security Details:

1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.

2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.

3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.

4) Details of connections to power supplies and grounding

5) Details of surge protection device installation

6) Sensor detection patterns – Each system sensor shall have associated detection patterns.

7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCI wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.

8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.

9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the

equipment room. The layout plan shall identify all equipment and details associated with the installation.

10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.

j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.

k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:

1) Item Number
2) Door Number (Derived from A/E Drawings)
3) Floor Plan Sheet Number
4) Standard Detail Number
5) Door Description (Derived from Loading Sheets)
6) Data Gathering Panel Input Number
7) Door Position or Monitoring Device Type & Model Number
8) Lock Type, Model Number & Power Input/Draw (standby/active)
9) Card Reader Type & Model Number
10) Shunting Device Type & Model Number
11) Sounder Type & Model Number
12) Manufacturer
13) Misc. devices as required
    a) Delayed Egress Type & Model Number
    b) Intercom
    c) Camera
    d) Electric Transfer Hinge
    e) Electric Pass-through device
14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
    a. Item Number
    b. Camera Number
    c. Naming Conventions
    d. Description of Camera Coverage
    e. Camera Location
    f. Floor Plan Sheet Number
    g. Camera Type
    h. Mounting Type
    i. Standard Detail Reference
    j. Power Input & Draw
    k. Power Panel Location
    l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
    a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
    b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
    c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output

connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.

d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.

e. The DGP spreadsheet shall include an entry section for the following information:
   1) DGP number
   2) First Reader Number
   3) First Monitor Point Number
   4) First Relay Number
   5) DGP, input or output Location
   6) DGP Chain Number
   7) DGP Cabinet Tamper Input Number
   8) DGP Power Fail Input Number
   9) Number of Monitor Points Reserved For Expansion Boards
   10) Number of Control Points (Relays) Reserved For Expansion Boards

f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
   1) System Numbers for Card Readers
   2) System Numbers for Monitor Point Inputs
   3) System Numbers for Control Points (Relays)
   4) Next DGP or input module First Monitor Point Number
   5) Next DGP or output module First Control Point Number

g. The DGP spreadsheet shall provide the following information for each card reader:
   1) DGP Reader Number
   2) System Reader Number
   3) Cable ID Number
   4) Description Field (Room Number)
   5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
   6) Description Field
   7) DGP Input Location

8) Date Test
9) Date Passed
10) Cable Type
11) Camera Numbers (of cameras viewing the reader location)

h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
1) DGP Monitor Point Input Number
2) System Monitor Point Number
3) Cable ID Number
4) Description Field (Room Number)
5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
7) DGP or input module Input Location
8) Date Test
9) Date Passed
10) Cable Type
11) Camera Numbers (of associated alarm event preset call-ups)

i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
1) DGP Control Point (Relay) Number
2) System (Control Point) Number
3) Cable ID Number
4) Description Field (Room Number)
5) Description Field (Device: Lock Control, Local Sounder, etc.)
6) Description Field
7) DGP or OUTPUT MODULE Output Location
8) Date Test
9) Date Passed Cable Type
10) Camera Number (of associated alarm event preset call-ups)

j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
1) Header
a) DGP Input and Output Worksheet

b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.

2) Footer

a) File Name

b) Date Printed

c) Page Number

4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
   a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
   b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
   c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

G. Group II Technical Data Package
   1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
   2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
      a. Baseline configuration
      b. Access levels
      c. Schedules (intrusion detection, physical access control, holidays, etc.)
      d. Badge database
      e. System monitoring and reporting (unit level and central control)
      f. Naming conventions and descriptors

H. Group III Technical Data Package
   1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.

I. Group IV Technical Data Package
   1. Performance Verification Test
      a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and

endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation
   a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
   b. New Unit Control Room:
      1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
      2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
      3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
      4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end

hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.

5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.

3. System Configuration and Data Entry:
   a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
      1) Physical Access control system components,
      2) All intrusion detection system components,
      3) Video surveillance, control and recording systems,
      4) Intercom systems components,
      5) All other security subsystems shown in the contract documents.
   b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
   c. Refer to Part 3 for system programming requirements and planning guidelines.
4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract

documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
   a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.

4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
   a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
   a. Equipment and/or system function.
   b. Operating characteristics.
   c. Limiting conditions.
   d. Performance curves.
   e. Engineering data and test.

f. Complete nomenclature and number of replacement parts.

g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.

h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.

i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.

j. Manufacturer equipment and systems maintenance manuals are permissible.

9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and

modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.

11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
    a. Certificates received instead of labels on bulk products.
    b. Testing and qualification of tradesmen. (“Contractor’s Qualifications”)
    c. Documented qualification of installation firms.
    d. Load and performance testing.
    e. Inspections and certifications.
    f. Final inspection and correction procedures.
    g. Project schedule
13. Record Construction Documents (Record As-Built)
    a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to

determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.

b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.

c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

K. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:

   a. Fingerprint Capture Station

   b. Card Readers

   c. Facial Image Capturing Camera

d. PIV Middelware

e. Template Matcher

f. Electromagnetically Opaque Sleeve

g. Certificate Management

1) CAK Authentication System

2) PIV Authentication System

3) Certificate Validator

4) Cryptographic Module

h. <list devices and software>

L. Approvals will be based on complete submission of manuals together with shop drawings.

M. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.

N. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI)/ International Code Council (ICC):

A117.1 .....Standard on Accessible and Usable Buildings and Facilities

C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):

AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards

CP-01-00.....Control Panel Standard-Features for False Alarm Reduction

PIR-01-00.....Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity

TVAC-01 .....CCTV to Access Control Standard - Message Set for System Integration

D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330-09 .....Electrical Performance Standards for CCTV Cameras

375A-76.....Electrical Performance Standards for CCTV Monitors

E. American National Standards Institute (ANSI):

ANSI S3.2-99.....Method for measuring the Intelligibility of Speech over Communications Systems

F. American Society for Testing and Materials (ASTM)

B1-07 .....Standard Specification for Hard-Drawn Copper Wire

B3-07 .....Standard Specification for Soft or Annealed Copper Wire

B8-04 .....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C1238-97 (R03) .....Standard Guide for Installation of Walk-Through Metal Detectors

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

G. Architectural Barriers Act (ABA), 1968

H. Department of Justice: American Disability Act (ADA)

28 CFR Part 36-2010 ADA Standards for Accessible Design

I. Department of Veterans Affairs:

VHA National CAD Standard Application Guide, 2006

VA BIM Guide, V1.0 10

J. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

K. Federal Information Processing Standards (FIPS):

FIPS-201-1 .....Personal Identity Verification (PIV) of Federal Employees and Contractors

L. Federal Specifications (Fed. Spec.):

A-A-59544-08 .....Cable and Wire, Electrical (Power, Fixed Installation)

M. Government Accountability Office (GAO):

GAO-03-8-02 ..... Security Responsibilities for Federally Owned and Leased Facilities

N. Homeland Security Presidential Directive (HSPD):

HSPD-12 ..... Policy for a Common Identification Standard for Federal Employees and Contractors

O. Institute of Electrical and Electronics Engineers (IEEE):

81-1983 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

802.3af-08 ..... Power over Ethernet Standard

802.3at-09 ..... Power over Ethernet (PoE) Plus Standard

C2-07 ..... National Electrical Safety Code

C62.41-02 ..... IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

C95.1-05 ..... Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields

P. International Organization for Standardization (ISO):

7810 ..... Identification cards – Physical characteristics

7811 ..... Physical Characteristics for Magnetic Stripe Cards

7816-1 ..... Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics

7816-2 ..... Identification cards - Integrated circuit cards - Part 2: Cards with contacts -Dimensions and location of the contacts

7816-3 ..... Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols

7816-4 ..... Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods

7816-10 ..... Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange

14443 ..... Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance

15693 ..... Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance

19794 ..... Information technology - Biometric data interchange formats

Q. National Electrical Contractors Association

303-2005 ..... Installing Closed Circuit Television (CCTV) Systems

R. National Electrical Manufactures Association (NEMA):

250-08 ..... Enclosures for Electrical Equipment (1000 Volts Maximum)

TC-3-04 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-07 ..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

S. National Fire Protection Association (NFPA):

70-11 ..... National Electrical Code (NEC)

731-08 ..... Standards for the Installation of Electric Premises Security Systems

99-2005 ..... Health Care Facilities

T. National Institute of Justice (NIJ)

0601.02-03 ..... Standards for Walk-Through Metal Detectors for use in Weapons Detection

0602.02-03 ..... Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection

U. National Institute of Standards and Technology (NIST):

IR 6887 V2.1 ..... Government Smart Card Interoperability Specification (GSC-IS)

Special Pub 800-37 ..... Guide for Applying the Risk Management Framework to Federal Information Systems

Special Pub 800-63 ..... Electronic Authentication Guideline

Special Pub 800-73-3 ..... Interfaces for Personal Identity Verification (4 Parts)

..... Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation

..... Pt. 2- PIV Card Application Card Command Interface

..... Pt. 3- PIV Client Application Programming Interface

..... Pt. 4- The PIV Transitional Interfaces & Data Model Specification

Special Pub 800-76-1 .....Biometric Data Specification for Personal Identity Verification

Special Pub 800-78-2 .....Cryptographic Algorithms and Key Sizes for Personal Identity Verification

Special Pub 800-79-1 .....Guidelines for the Accreditation of Personal Identity Verification Card Issuers

Special Pub 800-85B-1 .....DRAFTPIV Data Model Test Guidelines

Special Pub 800-85A-2 .....PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

Special Pub 800-104A .....Scheme for PIV Visual Card Topography

V. Occupational and Safety Health Administration (OSHA):

29 CFR 1910.97 .....Nonionizing radiation

W. Section 508 of the Rehabilitation Act of 1973

X. Security Industry Association (SIA):

AG-01 .....Security CAD Symbols Standards

Y. Underwriters Laboratories, Inc. (UL):

1-05 .....Flexible Metal Conduit

5-04 .....Surface Metal Raceway and Fittings

6-07 .....Rigid Metal Conduit

44-05 .....Thermoset-Insulated Wires and Cables

50-07 .....Enclosures for Electrical Equipment

83-08 .....Thermoplastic-Insulated Wires and Cables

294-99 .....The Standard of Safety for Access Control System Units

305-08 .....Standard for Panic Hardware

360-09 .....Liquid-Tight Flexible Steel Conduit

444-08 .....Safety Communications Cables

464-09 .....Audible Signal Appliances

467-07 .....Electrical Grounding and Bonding Equipment

486A-03.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-04 .....Splicing Wire Connectors

486D-05.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00 .....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-07 .....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514A-04.....Metallic Outlet Boxes

514B-04.....Fittings for Cable and Conduit

51-05 .....Schedule 40 and 80 Rigid PVC Conduit

609-96 .....Local Burglar Alarm Units and Systems

634-07 .....Standards for Connectors with Burglar-Alarm Systems

636-01 .....Standard for Holdup Alarm Units and Systems

639-97 .....Standard for Intrusion-Detection Units

651-05 .....Schedule 40 and 80 Rigid PVC Conduit

651A-07.....Type EB and A Rigid PVC Conduit and HDPE Conduit

752-05 .....Standard for Bullet-Resisting Equipment

797-07 .....Electrical Metallic Tubing

827-08 .....Central Station Alarm Services

1037-09 .....Standard for Anti-theft Alarms and Devices

1635-10 .....Digital Alarm Communicator System Units

1076-95 .....Standards for Proprietary Burglar Alarm Units and Systems

1242-06 .....Intermediate Metal Conduit

1479-03 .....Fire Tests of Through-Penetration Fire Stops

1981-03 .....Central Station Automation System

2058-05 .....High Security Electronic Locks

60950 .....Safety of Information Technology Equipment

60950-1 .....Information Technology Equipment - Safety - Part 1: General Requirements

Z. Uniform Federal Accessibility Standards (UFAS) 1984

AA. United States Department of Commerce:

Special Pub 500-101 .....Care and Handling of Computer Magnetic Storage Media

1.8 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

A. General Requirements
   1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work
   1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel
   1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative,

and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

E. System Inspections

1. These inspections shall include:
   a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
      1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
      2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

F. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
   a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
   b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

G. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

H. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

I. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

J. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

K. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be

recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.10 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 DELIVERY, STORAGE, & HANDLING

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

B. Central Station, Workstations, and Controllers:

1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.

4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.12 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
   2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
   3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
   4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
   5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.
C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.13 EQUIPMENT AND MATERIALS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.14 ELECTRICAL POWER

A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.

B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for [8] <insert hours> hours of operation at actual connected load. Requirements for additional power or locations shall be included with

the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.

1. Emergency Generator
    a. Report Printers: Unit Control Room
    b. Video Monitors: Unit Control Room
    c. Intercom Stations
    d. Radio System
    e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
    f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
    g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
    h. Telephone/Radio Recording Equipment: Unit Control Room.
    i. VASS Camera Power Supplies: Security Closets
    j. VASS Pan/Tilt Units: Various Locations
    k. VASS Outdoor Housing Heaters and Blowers: Various Sites
    l. Intercom Master Control System
    m. Fiber Optic Receivers/Transmitters
    n. Security office Weapons Storage
    o. Outlets that charge handheld radios
2. Uninterruptible Power Supply (UPS) on Emergency Power
    a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
        1) Security System Monitors and Keyboards: Control Room
        2) CPU: Control Equipment Room
        3) Communications equipment: Control Equipment Room and various sites.
        4) VASS Matrix Switcher: Control Equipment Room
        5) VASS: Control Equipment Room
        6) Digital Video Recorders, encoders & decoders: Control Room
        7) All equipment Room racked equipment.
        8) Network switches

1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING

A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.

1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.

B. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.

6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

1.16 COMPONENT ENCLOSURES

A. Construction of Enclosures
   1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
   2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
   3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
   4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
   5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).
B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
   1. Vertical Equipment Racks:

a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.

b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.

c. d. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.

2. Console racks:

a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.

b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.

C. Tamper Provisions and Tamper Switches:

1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.

2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sign to any internal component before the switch activates.

3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be

adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessing with common tools to bypass when the enclosure is in the secured mode.

4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.17 ELECTRONIC COMPONENTS

A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.18 SUBSTITUTE MATERIALS & EQUIPMENT

A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:

1. Identity of the material or devices specified for which there is a proposed substitution.

2. Description of the segment of the specification where the material or devices are referenced.
3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.

C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COTR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.19 LIKE ITEMS

A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.20 WARRANTY

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it’s failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.22 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.

B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of [8] ~~<insert hours>~~ hours of run time in the event of a loss of primary power to the facility.

C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.

D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

A. The Security Management System shall provide full interface with all components of the security subsystem as follows:

1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
3. Controlling devices shall be utilized to interface the SMS with all field devices.
4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:

a. Security Console Bays and Equipment Racks
b. Security Network Server and Workstation
c. CCTV Monitoring, Controlling, and Recording Equipment
d. PACS Monitoring and Controlling Equipment
e. IDS Monitoring and Controlling Equipment
f. Security Access Detection Monitoring Equipment
g. EPPS Monitoring and Controlling Equipment
h. Main Panels for all Security Systems
i. Power Supply Units (PSU) for all field devices
j. Life safety and power monitoring equipment
k. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.

B. Security Console Bays - shall be EIA 310D compliant and:
1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.
2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.
4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
5. Shall be mounted on lockable casters.
6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.

8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.
10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearing be identified as such.
13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the Contracting Officer.
14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)
Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front
Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
   a. 500 square feet for a large Access Control System and Database Management.
   b. 300 square feet for a small Access Control System and Database Management.
   c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.
3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close approximately to major utility areas, or near an exposed air intake(s).
5. Access shall meet UFAS and ADA accessibility requirements.
6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum or four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a

service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.

8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
11. Shall utilize a fire suppression system similar to that used by the VA's computer and telecommunications room operating areas.
12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.
13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in the event of electrical failure of the PACS, card reader, or locking mechanism.
14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.
16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.

D. Security Control Room Ventilation

1. Shall meet or exceed all requirements laid out in VA Master Specification listed in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.

2. Controls shall be via a separate air handling system that provides an isolated supply and return system. The Security Control Room shall have a dedicated thermostat control unit and cut-off switch to be able to shut off ventilation to the control room in the event of a chemical, biological, or radiological (CBR) event or other related emergency.
3. There shall be a louver installed in the control room door to assist with ventilation of the room. The louver shall be exactly 12 x 12 inches (30 x 30 cm) and closeable.

E. Security Control Room and Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Control Room and console area:
   a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.
   b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.
2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

F. Remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:

1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
3. Secondary stations shall not have priority over a primary Security Control Console.
4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.

G. Wires and Cables:

1. Shall meet or exceed the manufactures recommendation for power and signals.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

2.3 FIBER OPTIC EQUIPMENT

A. 8 Channel Fiber Optic Transcievers (Video&PTZ Control)

1. The field-located and central-located fiber optic transceivers shall utilize wave division multiplexing to transmit and receive video and data pan-tilt-zoom control signals over two standard 62.5/125 multimode fibers.
2. The units shall be capable of operating over a range of 2 km.
3. The units shall be NTSC color compatible.
4. The units shall support data rates up to 64 Kbps.
5. The units shall be surface or rack mountable.

6. The units shall be UL listed.
7. The units shall meet or exceed the following specifications:
   a. Video
      1) Input/Output: 1 volt pk-pk (75 ohms)
      2) Input/Output Channels: 8
      3) Bandwidth: 10 Hz - 6.5 MHZ per channel
      4) Differential Gain: <2%
      5) Differential Phase: <0.7°
      6) Tilt:<1%
      7) Signal to Noise Ratio: 60 dB
   b. Data (Control)
      1) Data Channels: 2
      2) Data Format: RS-232, RS-422, 2 wire or 4 wire RS-485 with Tri-State Manchester Bi-Phase and Sensornet
      3) Data Rate: DC - 100 kbps (NRZ)
      4) Bit Error Rate: < 1 in 10-9 @ Maximum Optical Loss Budget
      5) Operating Mode: Simplex or Full-Duplex
      6) Wavelength: 1310/1550 nm, Multimode or Singlemode
      7) Optical Emitter: Laser Diode
      8) Number of Fibers: 1
   c. Connectors
      1) Optical: ST
      2) Power and Data: Terminal Block with Screw Clamps
      3) Video: BNC (Gold Plated Center-Pin)
   d. Electrical and Mechanical
      1) Power: 12 VDC @ 500 mA (stand-alone)
      3) Current Protection: Automatic Resettable Solid-State Current Limiters
   e. Environmental
      1) MTBF: > 100,000 hours
      2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
      3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
      4) Relative Humidity: 0% to 95% (non-condensing)

B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:
   a. Video
      1) Input: 1 volt pk-pk (75 ohms)
      2) Bandwidth: 5H2 - 10 MHZ
      3) Differential Gain: <5%
      4) Tilt: <1%
      5) Signal-Noise: 60db
      6) Wavelength: 850nm
      7) Number of Fibers: 1
      8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
      9) Connectors:
         a) Power: Female plug with screw clamps
         b) Video: BNC
         c) Optical: ST
      10) Power: 12 VDC

C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:
   a. Video
      1) Output: 1 volt pk-pk (75 ohms)

2) Bandwidth: 5H2 - 10 MHZ
3) Differential Gain: <5%
4) Tilt:<1%
5) Signal-Noise: 60dB
6) Wavelength: 850nm
7) Number of Fibers: 1
8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
10) Connectors:
11) Power: Female plug block with screw clamps
12) Video: BNC
13) Optical: ST
14) Power: 12 VAC8 Channel Fiber Optic Transcievers (Video&PTZ Control)

D. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.

a. Specifications

1) Card Orientation: Vertical
2) Construction: Aluminum
3) Current Consumption: 0.99 A
4) Humidity: 95.0 % RH
5) Input Power: 100-240 VAC, 60/50 Hz
6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
7) Number of Outputs: 1.0
8) Number of Slots 15.0
9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
10) Ouput Voltage: 13.5 V
11) Output Current 6.0 A
12) Power Dissipation: 28.0 W
13) Power Factor: 48.0

14) Power Supply: (built-in)
15) Rack Units: 3RU
16) Redundant Capability: Yes
17) Weight: 2.43 kg (5.35 lb)
18) Width: 483 mm (19.0 in)

2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESION

A. Transient Voltage Surge Suppression

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
   a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
   b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
   c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
   d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
   a. UL1449 2nd Edition, 2007, listed
   b. UL1449 S.V.R. of 400 Volts or lower
   c. Status Indicator Light(s)
   d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20 µsec)
   e. Maximum Continuous Current: 15 Amps

f. MCOV: 125 VAC

g. Service Voltage: 110-120 VAC

2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:

a. UL 497B

b. Minimum Surge Current Capacity: 2,000 Amps per pair

c. Maximum Continuous Current: 5 Amps

d. MCOV: 33 Volts

e. Service Voltage: 24Volts

3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:

a. Conforms with UL497B standards (where applicable)

b. Clamp level for 12 and 24V power: 18VDC / 38VDC

c. Clamp level for Data/LED: 6.8VDC

d. Service Voltage for Power: 12VDC/24VDC

e. Service Voltage for Data/LED: <5VDC

f. Clamp level – PoE Access Power: 72V

g. Clamp level – PoE Access Data: 7.9V

h. Service Voltage – PoE Access: 48VAC – 54VAC

i. Service Voltage – PoE Data: <5VDC

C. Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:

a. UL 1449 Listed

b. UL 1449 S.V.R. of 400 Volts or lower

c. Diagnostic Indicator Light(s)

d. Integrated ground terminating post (where case/chassis ground exists)

e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20 µSec)

2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:

a. UL 497A Listed

b. Multi Stage protection design

c. Auto-reset current protection not to exceed 2 Amps per pair

d. Minimum Surge Current of 500 Amps per pair (8 x 20 µSec)

3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:

a. UL 497A Listed (where applicable)

b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)

c. Multi Stage protection design

d. Auto-reset over-current protection not to exceed 5 Amps per pair

e. Minimum Surge Current of 1000 Amps per pair (8 x 20 µSec)

D. Intrusion Detection Systems

1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:

a. UL 1449, 2nd Edition 2007, listed

b. UL 1449 S.V.R. of 400 Volts or lower

c. Status Indicator Lights

d. Center screw for terminating Class II transformers

e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 µSec)

2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:

a. UL 497A Listed

b. Multi Stage protection design

c. Surge Current Capacity: 9,000 Amps (8x20 µSec)

d. Clamp Voltage: 130Vrms

e. Auto reset current protection not to exceed 150 milliAmps

3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:

a. UL 497B for data communications or annunciation (powered loops)

b. Fail-short/fail-safe mode.

c. Surge Current Capacity: 9,000 Amps (8x20 µSec)

d. Clamp Voltage: 15 Vrms

e. Joule Rating: 76 Joules per pair (10x1000 µSec)

f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.

E. Video Surveillance System

1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:

a. Head-End Power

1) UL 1778, cUL (Battery Back Up)

2) Minimum Surge Current Capacity: 65,000 Amps (8x20µsec)

3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)

4) All modes protected (L-N, L-G, N-G)

5) EMI/RFI Filtering

6) Maximum Continuous Current: 12 Amps

b. Camera Power

1) Minimum Surge Current Capacity: 1,000 Amps (8X20µsec); 240 Amps for IP Video/PoE cameras

2) Screw Terminal Connection

3) All protection modes L-G (all Lines)

4) MCOV <40VAC

c. Video And Data

1) Surge Current Capacity 1,000 Amps per conductor

2) “BNC” Connection (Coax)

3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)

4) Band Pass 0-2GHz

5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. The Contractor shall engineer, provide, ad install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufactures' installation instructions.

G. 120 VAC Surge Suppression
1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

2.5 INSTALLATION KIT

A. General:
1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct

bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:

2. System Grounding:
   a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
   b. This includes, but is not limited to:
      1) Coaxial Cable Shields
      2) Control Cable Shields
      3) Data Cable Shields
      4) Equipment Racks
      5) Equipment Cabinets
      6) Conduits
      7) Cable Duct blocks
      8) Cable Trays
      9) Power Panels
      10) Grounding
      11) Connector Panels
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.

7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3 – EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Equipment location shall be as close as practical to locations shown on the drawings.

G. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping

materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

3.3 COMMISIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISIONIN OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 – COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

D. Provide services of manufacturer's technical representative for <insert hours> hours to instruct VA personnel in operation and maintenance of units.

E. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

3.5 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.6 SYSTEM PROGRAMMING

A. General Programming Requirements

1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms)]. System programming for existing or new SMS servers shall not be conducted at the project site.

B. Level of Effort for Programming

1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:
    a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.
    b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be

responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

2. The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

	Description of Tasks						
Description of Systems	Develop System Loading Sheets	Coordination	Initial Set-up Configuration	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)

SMS Setup & Configuration	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurations	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., check all system diagnostics (e.g., clients, panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log, Keystrokes, mouse clicks, multi-screen configuration

Electronic Entry Control Systems	e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., performing entry testing to confirm correct set-up and configuration	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations

Intrusion Detection Systems	e.g., enter door groups & schedules, link devices - REX, lock, & graphics	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., enter door groups & schedules, link devices - REX, lock, & graphics	e.g., walk test, device position, and masking	e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,

CCTV Systems	e.g., programming call-ups recording	e.g., confirming device configurations, naming conventions	e.g., enter data from loading sheets; camera naming convention, sequences, configure components)		e.g., programming call-ups recording	e.g., confirm area of coverage, call-up per event generated and recording rates	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Intercoms Systems	e.g., programming events & call-ups	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., programming events & call-ups	e.g., confirm operation, SMS event generation and camera call-up	e.g., setup linkages, events for activations, device troubles, land devices on graphic maps
Console Monitoring Components	N/A	per monitor	per monitor	per graphic map	N/A	per monitor	N/A
Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.							

Table 1 Contractor Level of Effort

3.7 TESTING AND ACCEPTANCE

A. Performance Requirements

1. General:

   a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.

   b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at the conclusion of each phase of testing and prior to Resident Engineer approval of the test.

2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.

D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.

E. Contractor's Field Testing (CFT)

1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting

complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

F. Performance Verification Test (PVT)

1. Test team:

   a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.

3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.
5. Additional Components of the PVT shall include:
   a. System Inventory
      1) All Device equipment
      2) All Software
      3) All Logon and Passwords
      4) All Cabling System Matrices
      5) All Cable Testing Documents
      6) All System and Cabinet Keys
   b. Inspection
      1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
      2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
6. Partial PVT - At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.

G. Endurance Test
1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as

specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.

2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
3. Phase II (Assessment):
   a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
   b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase I be repeated.

4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.
5. Phase IV (Assessment):
    1. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
    2. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

H. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
    a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
    b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
    c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

- - - E N D - - -

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

D. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

E. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.

F. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

G. RCDD: Registered Communications Distribution Designer.

H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

J. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

A. See section 28 05 00, Paragraph 1.4.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
   e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
4. Wiring Diagrams. Show typical wiring schematics including the following:
   a. Workstation outlets, jacks, and jack assemblies.
   b. Patch cords.
   c. Patch panels.
5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-05.....Thermoset-Insulated Wires and Cables

83-08.....Thermoplastic-Insulated Wires and Cables

467-07.....Electrical Grounding and Bonding Equipment

486A-03.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-04.....Splicing Wire Connectors

486D-05.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514B-04.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use [optical-fiber flashlight] [or] [optical loss test set] <Insert test>.

2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

General: All cabling locations shall be in conduit systems as outlined in Division 28 unless a waiver is granted in writing or an exception is noted on the construction drawings.

A. Support of Open Cabling: NRTL labeled for support of [Category 5e] [Category 6] cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars and spools.
   3. Straps and other devices.
B. Cable Trays:
   1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by [electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick] [hot-dip galvanizing, complying with ASTM A 123/A 123M Grade 0.55, not less than 0.002165 inch (0.055 mm) thick].
   2. Basket Cable Trays: [6 inches (150 mm) wide and 2 inches (50 mm) deep] <Insert dimensions>. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   3. Trough Cable Trays: [Nominally 6 inches (150 mm)] <Insert dimension> wide.
   4. Ladder Cable Trays: [Nominally 18 inches (455 mm)] <Insert dimension> wide, and a rung spacing of [12 inches (305 mm)] <Insert spacing>.
   5. Channel Cable Trays: One-piece construction, [nominally 4 inches (100 mm)] <Insert dimension> wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.

6. Solid-Bottom Cable Trays: One-piece construction, [nominally 12 inches (305 mm)] <Insert dimension> wide. Provide [with] [without] solid covers.

C. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems."[Flexible metal conduit shall not be used.]

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, [Category 5e] [Category 6].
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, General Purpose: Type CM or CMG [; or MPP, CMP, MPR, CMR, MP, or MPG].
   b. Communications, Plenum Rated: Type CMP [; or MPP], complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR [; or MPP, CMP, or MPR], complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX[; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG].
   e. Multipurpose: Type MP or MPG [; or MPP or MPR].
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
   g. Multipurpose, Riser Rated: Type MPR [or MPP], complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

B. Connecting Blocks: [110-style for Category 5e] [110-style for Category 6] [66-style for Category 5e]. Provide blocks for the number of cables terminated on the block, plus [25] <Insert

percentage> percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Description: Multimode, [50/125] [62.5/125]-micrometer, [24] <Insert number>-fiber, [nonconductive,] tight buffer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-B.3 for performance specifications.
   3. Comply with [TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A] for detailed specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
      a. General Purpose, Nonconductive: Type OFN or OFNG [, or OFNR, OFNP].
      b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
      c. Riser Rated, Nonconductive: Type OFNR [or OFNP], complying with UL 1666.
      d. General Purpose, Conductive: Type OFC or OFCG [; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP].
      e. Plenum Rated, Conductive: Type OFCP [or OFNP], complying with NFPA 262.
      f. Riser Rated, Conductive: Type OFCR [; or OFNR, OFCP, or OFNP], complying with UL 1666.
   5. Conductive cable shall be [steel] [aluminum] armored type.
   6. Maximum Attenuation: [3.50] <Insert number> dB/km at 850 nm; [1.5] <Insert number> dB/km at 1300 nm.
   7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
B. Jacket:
   1. Jacket Color: [Aqua for 50/125-micrometer cable] [Orange for 62.5/125-micrometer cable].
   2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
   3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, [Type SC] [Type ST] [Type LC] [Type MT-RJ] connectors. Insertion loss shall be not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

B. RG-11/U: NFPA 70, Type CATV.
   1. No. [14] <Insert size> AWG, solid, copper-covered steel conductor.
   2. Gas-injected, foam-PE insulation.
   3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
   4. Jacketed with sunlight-resistant, black PVC or PE.
   5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

C. RG59/U: NFPA 70, Type CATVR.
   1. No. [20] <Insert size> AWG, solid, silver-plated, copper-covered steel conductor.
   2. Gas-injected, foam-PE insulation.
   3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
   4. Color-coded PVC jacket.

D. RG-6/U: NFPA 70, Type CATV or CM.
   1. No. [16] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
   2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   3. Jacketed with black PVC or PE.
   4. Suitable for indoor installations.

E. RG59/U: NFPA 70, Type CATV.
   1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
   2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
   3. PVC jacket.

F. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
3. Copolymer jacket.

G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV[, or CATVP or CATVR].
2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
3. CATV Riser Rated: Type CATVR[; or CATVP, CATVR, or CATV], complying with UL 1666.
4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM[or CMG].

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.11 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.

2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.12 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
B. Class 2 Control Circuits: Stranded copper, [Type THHN-THWN, in raceway] [power-limited cable, concealed in building finishes] [power-limited tray cable, in cable tray] complying with UL 83.
C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.13 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
B. Signaling Line Circuits: Twisted, shielded pair, [not less than] [No. 18 AWG] [<Insert wire size> AWG] [size as recommended by system manufacturer].
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 16 AWG, minimum.
   2. Line-Voltage Circuits: No. 12 AWG, minimum.
   3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor[with outer jacket] with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.14 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.
B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

2.16 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.17 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable:
   a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
   b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
   c. Use ropes made of nonmetallic material for pulling feeders.
   d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer/COTR.
   e. Pull in multiple cables together in a single conduit.

C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
   1. Splices and terminations shall be mechanically and electrically secure.
   2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.

F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

J. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

K. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

L. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1525 mm)] <Insert dimension> apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

M. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [72 inches (1830 mm)] <Insert size> long shall be neatly coiled not less than [12 inches (300 mm)] <Insert size> in diameter below each feed point.

N. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

O. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is[not] permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables [may] [shall not] be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONTROL CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.

D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.

E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."

B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

B. Install a permanent wire marker on each wire at each termination.

C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

D. Wire markers shall retain their markings after cleaning.

E. In each handhole, install embossed brass tags to identify the system served and function.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 EXISITNG WIRING

A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused.

If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

- - - E N D - - -

SECTION 28 05 26
GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.

C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 26 41 00 - FACILITY LIGHTNING PROTECTION. Requirements for a lightning protection system.

C. Section 28 05 00 - REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.

D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.

E. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

1.3 SUBMITTALS

A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

B. Shop Drawings:

1. Clearly present enough information to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
   1. Certification that the materials and installation are in accordance with the drawings and specifications.
   2. Certification by the contractor that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Society for Testing and Materials (ASTM):

B1-07 ..... Standard Specification for Hard-Drawn Copper Wire

B3-07 ..... Standard Specification for Soft or Annealed Copper Wire

B8-04 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C2-07 ..... National Electrical Safety Code

D. National Fire Protection Association (NFPA):

70-11 ..... National Electrical Code (NEC)

99-2005 ..... Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-05 ..... Thermoset-Insulated Wires and Cables

83-08 ..... Thermoplastic-Insulated Wires and Cables

467-07 ..... Grounding and Bonding Equipment

486A-486B-03 ..... Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for

all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections

B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

C. Below Grade: Exothermic-welded type connectors.

D. Above Grade:

1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

   a) Pipe Connectors: Clamp type, sized for pipe.
6. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.5 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.6 SPLICE CASE GROUND ACCESSORIES

A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.7 COMPUTER ROOM GROUND

A. Provide 50mm2 (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

2.8 SECURITY CONTROL ROOM GROUND

A. Provide 50mm2 (1/0 AWG) stranded copper grounding conductor(s) color coded with a green jacket, bolted at the Room's Communications System Grounding Electrode Cooper Plate and circulate to each equipment rack ground buss bar through the wire management system. Connect each equipment rack, wire management system's cable tray, ladder, etc. to the circulating ground wire with a minimum 25mm2 (4AWG) stranded Cooper Wire, color coded with a green jacket.

1. Connect each equipment rack ground buss bar to the circulating ground wire a indicated in 2.9.A, and
2. Connect each additional room item to the circulating ground wire as indicated in 2.9.A.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.4 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 COMPUTER ROOM/SECURITY EQUIPMENT ROOM GROUNDING

A. Conduit: Ground and bond metallic conduit systems as follows:
   1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm² (6AWG) bonding jumpers.
   2. Bond at all intermediate metallic enclosures and across all joints using 16 mm² (6 AWG) bonding jumpers.

3.6 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:
   1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
   2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
   3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
   4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.7 LIGHTNING PROTECTION SYSTEM

A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third of fourth ground electrode system, or the

telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connected the lightning protection system at the direction of the Resident Engineer certified by an independent certified grounding contractor.

3.8 EXTERIOR LIGHT/CAMERA POLES

A. Provide 20 ft [6.1 M] of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.9 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Services at power company interface points shall comply with the power company ground resistance requirements.

3.10 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.11 GROUNDING FOR RF/EMI CONTROL

A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches)

wide copper strip or two 6 mm² (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm² (6 AWG) copper where exposed and subject to damage.

B. Comply with the following when shielded cable is used for data circuits.
   1. Shields shall be continuous throughout each circuit.
   2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
   3. Do not connect shields from different circuits together.
   4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

3.12 LABELING

A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
2. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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SECTION 28 05 28.33
CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 06 10 00 - ROUGH CARPENTRY. Requirements for mounting board for communication closets.

C. Section 07 84 00 - FIRESTOPPING. Requirements for sealing around penetrations to maintain the integrity of fire rated construction.

D. Section 07 60 00 - FLASHING AND SHEET METAL. Requirements for fabrications for the deflection of water away from the building envelope at penetrations.

E. Section 07 92 00 - JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

F. Section 09 91 00 - PAINTING. Requirements for identification and painting of conduit and other devices.

G. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.

H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

I. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquid tight flexible metal conduit.

G. LFNC: Liquid tight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

1.5 SUBMITTALS

A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:

B. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

C. Certification: Prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. Handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.
      c. Grounding details.
      d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
      e. Joint details.

G. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):

TC-3-04 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-07 ..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

C. National Fire Protection Association (NFPA):

70-11 ..... National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

1-05 ..... Flexible Metal Conduit

5-04 ..... Surface Metal Raceway and Fittings

6-07 ..... Rigid Metal Conduit

50-07 ..... Enclosures for Electrical Equipment

360-09 ..... Liquid-Tight Flexible Steel Conduit

467-07 ..... Grounding and Bonding Equipment

514A-04 ..... Metallic Outlet Boxes

514B-04 ..... Fittings for Cable and Conduit

514C-02 ..... Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers

651-05 ..... Schedule 40 and 80 Rigid PVC Conduit

651A-07 ..... Type EB and A Rigid PVC Conduit and HDPE Conduit

797-07 ..... Electrical Metallic Tubing

1242-06 ..... Intermediate Metal Conduit

PART 2 - PRODUCTS

2.1 GENERAL

A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

2.2. CONDUIT

A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.

B. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.

C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.

E. Flexible galvanized steel conduit: Shall Conform to UL 1.

F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.

G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

2.3. WIREWAYS AND RACEWAYS

A. Surface metal raceway: Shall Conform to UL 5.

2.4. CONDUIT FITTINGS

A. Rigid steel and IMC conduit fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
4. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

5. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
6. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

B. Rigid aluminum conduit fittings:
1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
2. Locknuts and bushings: As specified for rigid steel and IMC conduit.
3. Set screw fittings: Not permitted for use with aluminum conduit.

C. Electrical metallic tubing fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Indent type connectors or couplings are prohibited.
5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

D. Flexible steel conduit fittings:
1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
2. Clamp type, with insulated throat.

E. Liquid-tight flexible metal conduit fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

F. Direct burial plastic conduit fittings:

1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
2. As recommended by the conduit manufacturer.

G. Surface metal raceway fittings: As recommended by the raceway manufacturer.

H. Expansion and deflection couplings:

1. Conform to UL 467 and UL 514B.
2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

2.5 CONDUIT SUPPORTS

A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.

B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.

D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

2.6 OUTLET, JUNCTION, AND PULL BOXES

A. UL-50 and UL-514A.

B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.

E. Sheet metal boxes: Galvanized steel, except where otherwise shown.

F. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

2.7 CABINETS

A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

B. Hinged door in front cover with flush latch and concealed hinge.

C. Key latch to match panelboards.

D. Metal barriers to separate wiring of different systems and voltage.

E. Accessory feet where required for freestanding equipment.

2.8 WIREWAYS

A. Equip with hinged covers, except where removable covers are shown.

2.9 WARNING TAPE

A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with “CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW”.

2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service. <Insert legend.>
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) <Insert dimensions> and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

2.11 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 84 00 "FIRESTOPPING."

2.12 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: [EPDM] [NBR] <Insert sealing element> interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: [Plastic] [Carbon steel] [Stainless steel]. Include two for each sealing element.
3. Connecting Bolts and Nuts: [Carbon steel with corrosion-resistant coating] [Stainless steel] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.13 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. WIRELINE DATA TRANSMISSION MEDIA FOR SECURITY SYSTEMS.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer/COTR prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer/COTR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

3.2 INSTALLATION, GENERAL

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:
   1. Make bends with standard conduit bending machines.
   2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
   3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:
   1. Install conduit with wiring, including homeruns, as shown.
   2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer/COTR.

D. Fire Alarm:
   1. Fire alarm conduit shall be painted red (a red “top-coated” conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, “FIRE DETECTION AND ALARM”.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:
   1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
   2. Align and run conduit in direct lines.
   3. Install conduit through concrete beams only when the following occurs:
      a. Where shown on the structural drawings.
      b. As approved by the Resident Engineer/COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
   4. Installation of conduit in concrete that is less than 75 mm (3 inch) thick is prohibited.
      a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
      b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
      c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
   5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
    a. Rigid steel or rigid aluminum.
    b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
2. Conduit for conductors 600 volts and below:
    a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors 600 volts and below:
    1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
C. Align and run conduit parallel or perpendicular to the building lines.
D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
F. Surface metal raceways: Use only where shown.
G. Painting:
    1. Paint exposed conduit as specified in Section09 91 00, “PAINTING”.
    2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, “PAINTING” for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

3.6 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.

F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

A. Install the electronic safety and security raceway system as shown on drawings.

B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.

C. All conduit ends shall be equipped with insulated bushings.

D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.

E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.

F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.

G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.

H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
¾	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

3.9 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – “COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS” for all inspection, start

up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00, "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -

DSECTION 28 13 00
PHYSICAL ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing, and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.

B. This Section includes a Physical Access Control System. Contractor shall provide field devices as indicated on plans to integrate with existing security panels and headend equipment. Prior to bid, contractor shall survey drawings and existing facility to ensure all required additional equipment or required modifications to the existing security controllers and system is provided in said bid. Contractor shall provide a complete and fully functional PACS system. The PACS equipment being added to the existing includes the following:

1. Physical Access Control:
   a. Card readers
   b. Motion detectors
   c. Sirens
   d. Door position Switch

C. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.

D. Information system supporting PACS, Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems) and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.

D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.

E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.

F. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.

G. Section 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

H. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.

I. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.

J. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

K. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

L. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.3 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.

B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

D. Product Qualifications:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

E. Contractor Qualifications:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System’s (PACS) manufacturer. The Contractor shall provide four (4) current

references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination, and testing.

F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.4 SUBMITTALS

A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

B. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

C. Provide certificates of compliance with Section 1.3, Quality Assurance.

D. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.

E. Shop drawing and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a complete list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
   a. Include a title block as defined above.
   b. Clearly define the drawings scale in both standard and metric measurements.
   c. Provide device identification and location.
   d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
   e. Identify all pull box and conduit locations, sizes, and fill capacities.
   f. Address all general and drawing specific notes for a particular drawing sheet.
3. A detailed riser drawing for each applicable security subsystem shall:
   a. Indicate the sequence of operation.
   b. Relationship of integrated components on one diagram.
   c. Include the number, size, identification, and maximum lengths of interconnecting wires.
   d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A

= 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.

4. A detailed system drawing for each applicable security system shall:
   a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
   b. Provide full detail of all system components wiring from point-to-point.
   c. Identify wire types utilized for connection, interconnection with associate security subsystems.
   d. Show device locations that correspond to the floor plans.
   e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).
   c. Mounting type (e.g. flush, wall, surface, etc.).
   d. Power supply or circuit breaker and power panel number.
   e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).
6. Detail and elevation drawings for all devices that define how they were installed and mounted.

F. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
   1. 35 percent
   2. 65 percent
   3. 90 percent
   4. 100 percent

G. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include

procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

H. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

I. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

J. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - DESIGN SUBMITTAL PROCEDURES, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data

Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.

6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
   a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
      1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and or maintenance of the component or system.
      2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
   b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
   c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
   d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20-pound white bond paper.
   e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
      1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
      2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.

3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.

f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:

1) General system or equipment description.
2) Design factors and assumptions.
3) Copies of applicable Shop Drawings and Product Data.
4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.

g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.

h. Title Page: Provide a title page as the first sheet of each manual to include the following information: project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.

i. Table of Contents: After the title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols, and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified

by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.

k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

l. Manufacturer’s Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

n. Calculations: Provide a section for circuit and panel calculations.

o. Loading Sheets: Provide a section for DGP Loading Sheets.

p. Certifications: Provide section for Contractor’s manufacturer certifications.

7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer’s catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor’s stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

K. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:
   a. General – Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings.
   b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area, and Vicinity Maps.
   c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
   d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8” tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
      1) security devices by symbol,
      2) the associated device point number (derived from the loading sheets),
      3) wire & cable types and counts
      4) conduit sizing and routing
      5) conduit riser systems
      6) device and area detail call outs

e. Architectural details – Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).

f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).

g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.

h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

i. Security Details:

1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.

2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.

3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.

4) Details of connections to power supplies and grounding

5) Details of surge protection device installation

6) Sensor detection patterns – Each system sensor shall have associated detection patterns.

7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCI wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
8) Security Control Room – The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
9) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation. Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
10) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.

j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.

k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
1) Item Number
2) Door Number (Derived from A/E Drawings)
3) Floor Plan Sheet Number
4) Standard Detail Number
5) Door Description (Derived from Loading Sheets)
6) Data Gathering Panel Input Number
7) Door Position or Monitoring Device Type & Model Number
8) Lock Type, Model Number & Power Input/Draw (standby/active)

9) Card Reader Type & Model Number
10) Shunting Device Type & Model Number
11) Sounder Type & Model Number
12) Manufacturer
13) Misc. devices as required
    a) Delayed Egress Type & Model Number
    b) Intercom
    c) Camera
    d) Electric Transfer Hinge
    e) Electric Pass-through device
14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
    a. Item Number
    b. Camera Number
    c. Naming Conventions
    d. Description of Camera Coverage
    e. Camera Location
    f. Floor Plan Sheet Number
    g. Camera Type
    h. Mounting Type
    i. Standard Detail Reference
    j. Power Input & Draw
    k. Power Panel Location
    l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
    a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built

documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.

b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.

c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output, and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.

d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.

e. The DGP spreadsheet shall include an entry section for the following information:
   1) DGP number
   2) First Reader Number
   3) First Monitor Point Number
   4) First Relay Number
   5) DGP, input or output Location
   6) DGP Chain Number
   7) DGP Cabinet Tamper Input Number
   8) DGP Power Fail Input Number
   9) Number of Monitor Points Reserved for Expansion Boards
   10) Number of Control Points (Relays) Reserved for Expansion Boards

f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
   1) System Numbers for Card Readers
   2) System Numbers for Monitor Point Inputs

3) System Numbers for Control Points (Relays)
4) Next DGP or input module First Monitor Point Number
5) Next DGP or output module First Control Point Number

g. The DGP spreadsheet shall provide the following information for each card reader:
1) DGP Reader Number
2) System Reader Number
3) Cable ID Number
4) Description Field (Room Number)
5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
6) Description Field
7) DGP Input Location
8) Date Test
9) Date Passed
10) Cable Type
11) Camera Numbers (of cameras viewing the reader location)

h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
1) DGP Monitor Point Input Number
2) System Monitor Point Number
3) Cable ID Number
4) Description Field (Room Number)
5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
6) DGP or input module Input Location
7) Date Test
8) Date Passed
9) Cable Type
10) Camera Numbers (of associated alarm event preset call-ups)

i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
1) DGP Control Point (Relay) Number
2) System (Control Point) Number
3) Cable ID Number

4) Description Field (Room Number)
5) Description Field (Device: Lock Control, Local Sounder, etc.)
6) Description Field
7) DGP or OUTPUT MODULE Output Location
8) Date Test
9) Date Passed Cable Type
10) Camera Number (of associated alarm event preset call-ups)

j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
   1) Header
      a) DGP Input and Output Worksheet
      b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
   2) Footer
      a) File Name
      b) Date Printed
      c) Page Number

4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
   a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response

time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.

b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.

c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.

7. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

L. Group II Technical Data Package

1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.

2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:

a. Baseline configuration

b. Access levels

c. Schedules (intrusion detection, physical access control, holidays, etc.)

d. Badge database

e. System monitoring and reporting (unit level and central control)

f. Naming conventions and descriptors

M. Group III Technical Data Package

1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the

test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.

N. Group IV Technical Data Package

1. Performance Verification Test

   a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout, and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation

   a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.

3. System Configuration and Data Entry:

   a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated into the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:

      1) Physical Access control system components,

      2) All intrusion detection system components,

3) Video surveillance, control and recording systems,
4) Intercom systems components,
5) All other security subsystems shown in the contract documents.

b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.

c. Refer to Part 3 for system programming requirements and planning guidelines.

4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

O. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
   a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
   a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
   a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.

7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
    a. Equipment and/or system function.
    b. Operating characteristics.
    c. Limiting conditions.
    d. Performance curves.
    e. Engineering data and test.
    f. Complete nomenclature and number of replacement parts.
    g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
    h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
    i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
    j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words ‘Master Redlines’ on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and

inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at any time.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities.

Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:

a. Certificates received instead of labels on bulk products.
b. Testing and qualification of tradesmen. (“Contractor’s Qualifications”)
c. Documented qualification of installation firms.
d. Load and performance testing.
e. Inspections and certifications.
f. Final inspection and correction procedures.
g. Project schedule

13. Record Construction Documents (Record As-Built)
    a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
    b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
    c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been

obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

P. FIPS 201 Compliance Certificates
   1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
      a. Card Readers
      b. PIV Middleware
      c. Certificate Management
         1) CAK Authentication System
         2) PIV Authentication System
         3) Certificate Validator
         4) Cryptographic Module

Q. Approvals will be based on complete submission of manuals together with shop drawings.

R. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.5 APPLICABLE PUBLICATIONS

A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

B. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):

AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards

TVAC-01 .....CCTV to Access Control Standard - Message Set for System Integration

D. American National Standards Institute (ANSI)/ International Code Council (ICC):

A117.1 .....Standard on Accessible and Usable Buildings and Facilities

E. Department of Justice American Disability Act (ADA)

28 CFR Part 36.....ADA Standards for Accessible Design 2010

F. Department of Veterans Affairs (VA):

PACS-R: Physical Access Control System (PACS) Requirements

VA Handbook 0730 Security and Law Enforcement

G. Government Accountability Office (GAO):

GAO-03-8-02 Security Responsibilities for Federally Owned and Leased Facilities

H. National Electrical Contractors Association

303-2005 .....Installing Closed Circuit Television (CCTV) Systems

I. National Electrical Manufactures Association (NEMA):

250-08 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

J. National Fire Protection Association (NFPA):

70-11 ..... National Electrical Code

K. Underwriters Laboratories, Inc. (UL):

294-99 .....The Standard of Safety for Access Control System Units

305-08 .....Standard for Panic Hardware

639-97 .....Standard for Intrusion-Detection Units

752-05 .....Standard for Bullet-Resisting Equipment

827-08 .....Central Station Alarm Services

1076-95 .....Standards for Proprietary Burglar Alarm Units and Systems

1981-03 .....Central Station Automation System

2058-05 .....High Security Electronic Locks

L. Homeland Security Presidential Directive (HSPD):

HSPD-12 .....Policy for a Common Identification Standard for Federal Employees and Contractors

M. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

N. Federal Information Processing Standards (FIPS):

FIPS-201-1 ..... Personal Identity Verification (PIV) of Federal Employees and Contractors

O. National Institute of Standards and Technology (NIST):

IR 6887 V2.1 ..... Government Smart Card Interoperability Specification (GSC-IS)

Special Pub 800-63..... Electronic Authentication Guideline

Special Pub 800-96..... PIV Card Reader Interoperability Guidelines

Special Pub 800-73-3 ..... Interfaces for Personal Identity Verification (4 Parts)

..... Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation

..... Pt. 2- PIV Card Application Card Command Interface

..... Pt. 3- PIV Client Application Programming Interface

..... Pt. 4- The PIV Transitional Interfaces & Data Model Specification

Special Pub 800-76-1 ..... Biometric Data Specification for Personal Identity Verification

Special Pub 800-78-2 ..... Cryptographic Algorithms and Key Sizes for Personal Identity Verification

Special Pub 800-79-1 ..... Guidelines for the Accreditation of Personal Identity Verification Card Issuers

Special Pub 800-85B-1 ..... DRAFTPIV Data Model Test Guidelines

Special Pub 800-85A-2 ..... PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)

Special Pub 800-96..... PIV Card Reader Interoperability Guidelines

Special Pub 800-37..... Guide for Applying the Risk Management Framework to Federal Information Systems

Special Pub 800-96..... PIV Card Reader Interoperability Guidelines

Special Pub 800-96..... PIV Card Reader Interoperability Guidelines

Special Pub 800-104A ..... Scheme for PIV Visual Card Topography

Special Pub 800-116..... Recommendation for the Use of PIV Credentials in Physical Access Control Systems (PACS)

P. Institute of Electrical and Electronics Engineers (IEEE):

C62.41 ..... IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

Q. International Organization for Standardization (ISO):

7810 ..... Identification cards – Physical characteristics

7811 ..... Physical Characteristics for Magnetic Stripe Cards

7816-1 ..... Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics

7816-2 ..... Identification cards - Integrated circuit cards - Part 2: Cards with contacts -Dimensions and location of the contacts

7816-3 ..... Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols

7816-4 ..... Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods

7816-10 ..... Identification cards - Integrated circuit cards - Part 4: Organization, security, and commands for interchange

14443 ..... Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance

15693 ..... Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance

19794 ..... Information technology - Biometric data interchange formats

R. Uniform Federal Accessibility Standards (UFAS) 1984

S. ADA Standards for Accessible Design 2010

T. Section 508 of the Rehabilitation Act of 1973

1.6 DEFINITIONS

A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.

B. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.

C. Access Control: A function or a system that restricts access to authorized persons only.

D. API Application Programming Interface

E. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels: M-04-04

1. Level 1: LITTLE OR NO confidence
2. Level 2: SOME confidence
3. Level 3: HIGH confidence
4. Level 4: VERY HIGH confidence

F. Authentication: A process that establishes the origin of information or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.

G. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.

H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).

I. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.

J. Biometric: An authenticator produced from measurable qualities of a living person.

K. CAC EP – CAC End Point with end point PIV applet

L. CAC NG – CAC Next Generation with transitional PIV applet

M. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. SP800-73 NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.

N. CCTV: Closed-circuit television.

O. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.

P. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

Q. CPU: Central processing unit.

R. Credential: Data assigned to an entity and used to identify that entity.

S. File Server: A PC in a network that stores the programs and data files shared by users.

T. FIPS Federal Information Processing Standards

U. FRAC – First Responder Authentication Credential

V. HSPD Homeland Security Presidential Directive

W. I/O: Input/Output.

X. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

Y. IEC International Electrotechnical Commission

Z. ISO International Organization for Standardization

AA. KB Kilobyte

BB. kbit/s Kilobits / second

CC. LAN: Local area network.

DD. LED: Light-emitting diode.

EE. Legacy CAC – Contact only Common Access Card with v1 and v2 applets

FF. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

GG. NIST: National Institute of Standards and Technology

HH. PACS: Physical Access Control System

II. PC/SC: Personal Computer / Smart Card

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. PIV: Personal Identification Verification

NN. PIV-I – PIV Interoperable credential

OO. PPS: Protocol and Parameters Selection

PP. RF: Radio frequency.

QQ. ROM: Read-only memory. ROM data are maintained through losses of power.

RR. RS-232: A TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

SS. RS-485: A TIA/EIA standard for multipoint communications.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. TPDU: Transport Protocol Data Unit

VV. TWIC – Transportation Worker Identification Credential

WW. UPS: Uninterruptible power supply.

XX. Vcc: Voltage at the Common Collector

YY. WAN: Wide area network.

ZZ. WAV: The digital audio format used in Microsoft Windows.

AAA. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.8 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working ours, Monday through Friday, excluding federal holidays. These inspections shall include:

a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.

1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
   a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from notification. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
   b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date, and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.9 PERFORMANCE REQUIREMENTS

A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.

B. All processing of authentication information must occur on the "safe side" of a door

C. Physical Access Control System shall provide access to following Security Areas:
   1. Controlled
   2. Limited
   3. Exclusion
D. PACS shall provide:
   1. One authentication factor for access to Controlled security areas
   2. Two authentication factors for access to Limited security areas
   3. Three authentication factors for access to Exclusion security areas
E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.
F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:
   1. Name chaining;
   2. Signature chaining;
   3. Certificate validity;
   4. Key usage, basic constraints, and certificate policies certificate extensions;
   5. Full CRLs; and
   6. CRLs segmented on names.
G. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for physical access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.
H. Data Capacity:
   1. 130 different card-reader formats.
   2. 999 comments.
   3. 16 graphic file types for importing maps.
I. Location Capacity:
   1. 128 reader-controlled doors.
   2. 50,000 total access credentials.
   3. 2048 supervised alarm inputs.

4. 2048 programmable outputs.
5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.

J. System Network Requirements:
1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication shall not require operator initiation or response and shall return to normal after partial or total network interruption such as power loss or transient upset.
3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
4. Communications Controller may be used as an interface between the Central Station display systems and the field device network. Communications Controller shall provide functions required to attain the specified network communications performance.

K. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.

L. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.

M. System Response to Alarms: Field device network shall provide a system end-to-end response time of 1 second(s) or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm occurs at the Central Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.

N. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.

O. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.

P. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

Q. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.

R. References to industry and trade association standards and codes are minimum installation requirement standards.

S. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.10 EQUIPMENT AND MATERIALS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.11 WARRANTY OF CONSTRUCTION.

A. Warrant PACS work subject to the Article “Warranty of Construction” of FAR clause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

1.12 GENERAL REQUIREMENTS

A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.

B. General requirements applicable to this section include:

1. General Arrangement of Contract Documents,
2. Delivery, Handling and Storage,
3. Project Conditions,
4. Electrical Power,
5. Lightning, Power Surge Suppression, and Grounding,
6. Electronic Components,
7. Substitute Materials and Equipment, and
8. Like Items.

PART 2 – PRODUCTS

2.1 GENERAL

A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.

B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available, then the Contracting Officer will approve the acceptance of prior to an installation.

C. PACS equipment shall meet or exceed all requirements listed below.

D. The additional equipment being added to the existing PACS shall be comprised of, but not limited to, the following components:

1. Keypads
2. Card Readers
3. Credential Cards
4. System Sensors and Related Equipment
5. Push Button Switches
6. Door and Gate Hardware interface
7. Cables
8. Transformers

2.2 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

2.3 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.

B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

D. Alarm Annunciation Controller:

1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network with dc line supervision on each of its alarm inputs.

a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.

b. Alarm-Line Supervision:

1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal, and for conditions as described in UL 1076 for line security equipment by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.

2) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.

c. Outputs: Managed by Central Station software.

2. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.

E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit pushbuttons.

a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.

b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
   1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
   2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

3. Inputs:
   a. Data from entry-control devices; use this input to change modes between access and secure.
   b. Database downloads and updates from the Central Station that include enrollment and privilege information.
4. Outputs:
   a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
   b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion alarm annunciation from sensors stimulated by authorized entries.
   c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
   d. Door Prop Alarm: If a portal is held open for longer than 20 seconds time listed in a schedule, alarm sounds.
5. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
6. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
   a. Store up to 1000 transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.

7. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
    a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
    b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
    c. Backup Power Supply Capacity: 90 minutes of battery supply. Submit battery and charger calculations.
    d. Power Monitoring: Provide manual dynamic battery load test, initiated, and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
        1) Trouble Alarm: Normal power off load assumed by battery.
        2) Trouble Alarm: Low battery.
        3) Alarm: Power off.

2.4 PIV MIDDLEWARE

A. PIV Middleware shall provide three-factor authentication, including biometric matching using a fingerprint capture device capable of single fingerprint capture. Unit shall enable digital certificates to be verified by security personnel using the issuer's certificate authority, SCVP, OCSP responder/repeater, or the TSA hot list for TWIC cardholders. All cards shall be validated using FIPS-201 challenge-response protocol in order to identify forged or cloned cards. PIV Middleware solution shall validate all PIV, TWIC, NG CAC, and FRAC cards. TWIC card FASC-Ns shall also be verified against a live or cached TSA hot list.

B. PIV Middleware shall have ability to:
    1. Verify cardholder identity and validates FIPS 201-compliant PIV-II, next-generation (NG) CAC, TWIC, or FRAC credentials in real-time

2. Perform three-factor authentication of cardholder using PIN, biometrics, and certificate (or serial numbers) detecting forged or cloned cards
3. Enroll FASC-N, photo, and pertinent cardholder information into PACS software
4. Automatically suspend a cardholder's badge if his or her PIV, TWIC, or CAC card certificate serial number is on the Certificate Revocation List (CRL)
5. Upload a cardholder transaction audit trail to central database or exports it to a .csv file for centralized transaction management
6. Be compatible with biometric mobile terminal for off-site verification and enrollment
7. Re-validate imported cardholder certificates on a periodic basis via the Internet
8. Operate with commercial, off-the-shelf (COTS) FIPS 201 PIV-II and ANSI INCITS 378-compliant fingerprint capture devices
9. Revalidate imported cardholder certificates at regular intervals, ensuring that the credentials used in PACS system are backed by a valid set of digital certificates. Digital certificates are verified against local OCSP repeater/validation authority using the issuer's validation authority, or Microsoft Crypto Application Programming Interface (API) on Windows XP SP3 or Vista.
10. Certificate Manager shall fully support SCVP and OCSP for fast, online validation.
11. Provide verification of TWIC credentials against a live TSA hot list.
12. Support uploading local transactions to a central database for consolidated activity reporting. This application shall support a variety of ODBC- or ADO-compliant databases, including Oracle, SQL Server 2005, Informix, DB2, and Firebird.
13. Provide user with ability to produce canned transaction log queries as well as creating queries directly from the SQL database.

C. PIV Middleware PC requirements:
   1. PIV Middleware software shall operate on Intel-based PC with minimum 1.8 GHz CPU, 1 GB RAM, 40 GB hard disk, and Microsoft Windows XP SP2 with Microsoft .NET Framework 2.0
   2. Unit shall fingerprint capture devices and smart card reader.

D. PIV Middleware shall be FIPS 201 approved product.

2.5 CARD READERS

A. Power: Card reader shall be powered from its associated Controller, including its standby power source.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be 800ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semi-flush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
   1. Indoors, controlled environment.
   2. Indoors, uncontrolled environment.
   3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: LED or other type of visual indicator display shall provide visual and audible status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.

F. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.

G. Shall be individually home run to the main panel.

H. Shall be installed in a manner that they comply with:
   1. The Uniform Federal Accessibility Standards (UFAS)
   2. The Americans with Disabilities Act (ADA)
   3. The ADA Standards for Accessible Design

I. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, card and/or biometrics, card and/or pin and/or biometrics, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201, and is ISO 14443 A or B, ISO/IEC 7816 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.

J. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.

K. Shall contain read head electronics, and a sender to encode digital door control signals.

L. LED’s shall be utilized to indicate card reader status and access status.

M. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked), which will go in effect during loss of communication with the main control panel.

N. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide tactile audible feedback.

O. Shall have a minimum of two programmable inputs and two programmable outputs.

P. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:

1. Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Communications protocol shall be compatible with the local processor.

Q. Shall include a Light Emitting Diode (LED) or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus five (5) degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

1. Shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.
2. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
3. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
4. Shall provide a means for users to indicate a duress situation by entering a special code.

R. PIV Contact Card Reader

1. Application Protocol Data Unit (APDU) Support: At a minimum, the contact interface shall support all card commands for contact-based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
2. Buffer Size: The reader must contain a buffer large enough to receive the maximum size frame permitted by International Organization for Standardization International Electrotechnical Commission (ISO/IEC) 7816-3:1997, Section 9.4.

3. Programming Voltage: PIV Readers shall not generate a Programming Voltage.
4. Support for Operating Class: PIV Readers shall support cards with Class A Vccs as defined in ISO/IEC 7816-3:1997 and ISO/IEC 7816-3:1997/Amd 1:2002.
5. Retrieval Time: Retrieval time[1] for 12.5 kilobytes (KB) of data through the contact interface of the reader shall not exceed 2.0 seconds.
6. Transmission Protocol: The PIV Reader shall support both the character-based T=0 protocol and block-based T=1 protocol as defined in ISO/IEC 7816-3:1997.
7. Support for PPS Procedure: The reader shall support Protocol and Parameters Selection (PPS) procedure by having the ability to read character TA1 of the Answer to Reset (ATR) sent by the card as defined in ISO/IEC 7816-3:1997.

S. Contactless Smart Cards and Readers

1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
2. The readers shall have "flash" download capability to accommodate card format changes.
3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
4. The card reader shall be contactless and meet or exceed the following technical characteristics:
    a. Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 – 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 – 232 bits. All Wiegand formats or the upgradeability from Low to Medium Levels can be field configured with the use of a command card.
    b. FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.
    c. Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1” to 2” (2.5 – 5 cm).
    d. APDU Support: At a minimum, the contactless interface shall support all card commands for contactless based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.

e. Buffer Size: The reader shall contain a buffer large enough to receive the maximum size frame permitted by ISO/IEC 7816-3, Section 9.4.

f. ISO 14443 Support: The PIV Reader shall support parts (1 through 4) of ISO/IEC 14443 as amended in the References of this publication.

g. Type A and B Communication Signal Interfaces: The contactless interface of the reader shall support both the Type A and Type B communication signal interfaces as defined in ISO/IEC 14443-2:2001.

h. Type A and B Initialization and Anti-Collision The contactless interface of the reader shall support both Type A and Type B initialization and anti-collision methods as defined in ISO/IEC 14443-3:2001.

i. Type A and B Transmission Protocols: The contactless interface of the reader shall support both Type A and Type B transmission protocols as defined in ISO/IEC 14443-4:2001.

j. Retrieval Time: Retrieval time for 4 KB of data through the contactless interface of the reader shall not exceed 2.0 seconds.

k. Transmission Speeds: The contactless interface of the reader shall support bit rates of fc/128 (~106 kbits/s), fc/64(~212 kbits/s), and configurable to allow activation/deactivation.

l. Readability Range: The reader shall not be able to read PIV card more than 10cm(4inch) from the reader

T. Installed base is HID #RK40, 921N.

2.6 KEYPADS

A. Designed for use with unique combinations of alphanumeric and other symbols as an Identifier. Keys of keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence. Communications protocol shall be compatible with Controller.

1. Keypad display or enclosure shall limit viewing angles of the keypad as follows:

a. Maximum Horizontal Viewing Angle: 5 degrees or less off in either direction of a vertical plane perpendicular to the plane of the face of the keypad display.

b. Maximum Vertical Viewing Angle: 15 degrees or less off in either direction of a horizontal plane perpendicular to the plane of the face of the keypad display.

2. Duress Codes: Provide duress situation indication by entering a special code.

B. Installed base is HID #RK40, 921N.

2.7 CREDENTIAL CARDS

A. Personal Identity Verification (PIV) credential cards shall comply to Federal Information Processing Standards Publication (FIPS) 201.

B. Visual Card Topography shall be compliant with NIST 800-104.

C. PIV logical credentials shall contain multiple data elements for the purpose of verifying the cardholder's identity at graduated assurance levels. These mandatory data elements shall collectively comprise the data model for PIV logical credentials, and include the following:

1. CHUID
2. PIN
3. PIV authentication data (one asymmetric key pair and corresponding certificate)

D. The credential card (PIV) shall be an ISO 14443 type smart card with contactless interface that operates at 13.56 MHZ.

2.8 SYSTEM SENSORS AND RELATED EQUIPMENT

A. The PACS (Physical Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:

B. Request to Exit Detectors:

1. Passive Infrared Request to Exit Motion Detector (REX PIR) (1) The Contractor shall provide a surface mounted motion detector to signal the physical access control system request to exit input. The motion detector shall be a passive infrared sensor designed for wall or ceiling mounting 2134 to 4572 mm (7 to 15 ft) height. The detector shall provide two (2) form “C” (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads. The detectors relays shall be user adjustable with a latch time from 1-60 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion. The detection pattern shall be adjustable plus or minus fourteen (± 14) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50-watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.

2. Installed base is Bosch #DS150i Series Request-to-exit.

C. Door Status Indicators:

1. Shall monitor and report door status to the SMS.
2. Door Position Sensor:
   a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
   b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
   c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in its place of a DPDT switch.
   d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
   e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).
   f. Door position switch installed base is George Risk Industries, Recessed ¾” Steel Door Switch Set #8080-TWG.

2.9 PUSH BUTTON SWITCHES

A. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.

1. Electrical Ratings:
   a. Minimum continuous current rating of 10 A at 120 V ac or 5 A at 240-V ac.
   b. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.
2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
3. Enclosures shall additionally be suitable for installation in the following locations:
   a. Indoors, controlled environment.
   b. Indoors, uncontrolled environment.

c. Outdoors.

4. Power: Push-button switches shall be powered from their associated Controller, using dc control.

2.10 INTERFACES

A. CCTV System Interface

1. An RS232 Ethernet interface associated driver, and controller shall be provided for connection of the SMS Central Computer to the CCTV Alarm interface and switcher. The interface shall provide alarm data to the CCTV Alarm interface for automatic camera call-up. If required, the Security Contractor shall be responsible for programming the command strings into the SMS Server.

B. Intercom System Interface

1. The CCTV call-up from intercom stations shall be through the intercom unit via RS232 Ethernet communications interface to the SMS system, then through the matrix switcher.

a. Application Software

1) Provides the interface between the Alarm Annunciation System and Operator, all sensors, local processors and data links, drive displays, report alarms, and report generation.

2) Software is categorized as System Software and Application Software. System Software must consist of software to support set-up, operation, hard drive back-ups and maintenance processor. Application Software must consist of software to provide the completion of Physical Access Control System.

C. Power Supplies:

1. Shall be UL rated and able to adequately power (enter number) entry control devices on a continuous base without failure.

2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ A
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated

BATTERY	Dependant on Output Voltage shall provide up to 10 Ah
OUTPUT CURRENT	10 amp max. @ 13.8 VDC 5 amp max. @ 27.6 VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)
BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

2.11 VIDEO AND CAMERA CONTROL

A. Control station or designated workstation displays live video from a CCTV source.
   1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
   2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
   3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.12 WIRES AND CABLES

A. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."

B. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

1. NFPA 70, Type CM.
2. Flame Resistance: UL 1581 Vertical Tray.

C. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

D. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).

E. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

F. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

G. Multiconductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
   1. NFPA 70, Type CMG.
   2. Flame Resistance: UL 1581 Vertical Tray.
   3. For TIA/EIA-RS-232 applications.

H. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   1. NFPA 70, Type CM.
   2. Flame Resistance: UL 1581 Vertical Tray.

I. Paired Readers and Wiegand Keypads Cable: Paired, 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-

polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

1. NFPA 70, Type CM.
2. Flame Resistance: UL 1581 Vertical Tray.

J. Plenum-Type, Paired, Readers and Wiegand Keypads Cable: Paired, 3 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

K. Plenum-Type, Multiconductor, Readers and Keypads Cable: 6 conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

L. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

1. NFPA 70, Type CMG.
2. Flame Resistance: UL 1581 Vertical Tray.

M. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

N. Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

1. NFPA 70, Type CMG.
2. Flame Resistance: UL 1581 Vertical Tray.

O. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.

1. NFPA 70, Type CMP.
2. Flame Resistance: NFPA 262 Flame Test.

P. Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
   1. NFPA 70, Type CMR.
   2. Flame Resistance: UL 1666 Riser Flame Test.

Q. Plenum-Type, Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

R. Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
   1. NFPA 70, Type CMG.

S. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
   1. NFPA 70, Type CMP.
   2. Flame Resistance: NFPA 262 Flame Test.

T. Elevator Travel Cable: Steel center core, with shielded, twisted pairs, No. 20 AWG conductor size.
   1. Steel Center Core Support: Preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
   2. Shielded Pairs: Insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
   3. Jute Filler: Electrical grade, dry.
   4. Binder: Helically wound synthetic fiber.
   5. Braid: Rayon or cotton braid applied with 95 percent coverage.
   6. Jacket: 60 deg C PVC specifically compounded for flexibility and abrasion resistance. UL VW-1 and CSA FT1 flame rated.

U. LAN (Ethernet) Cabling: Comply with Division 28 Section "Conductors and Cables for Electronic Safety and Security."

2.13 INTRUSION MOTION DETECTOR

A. Installed base is Bosch #DS9370.

2.14 INTRUSION MOTION DETECTOR

A. Installed base is Amseco #SSX-52.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

3.3 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.

1. Record setup data for control station and workstations.
2. For each Location, record setup of Controller features and access requirements.
3. Propose start and stop times for time zones and holidays and match up access levels for doors.
4. Set up groups, linking, and list inputs and outputs for each Controller.
5. Assign action message names and compose messages.
6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
7. Prepare and install alarm graphic maps.
8. Develop user-defined fields.
9. Develop screen layout formats.
10. Propose setups for guard tours and key control.
11. Discuss badge layout options, design badges.
12. Complete system diagnostics and operation verification.
13. Prepare a specific plan for system testing, startup, and demonstration.
14. Develop acceptance test concept and, on approval, develop specifics of the test.
15. Develop cable and asset management system details, input data from construction documents. Include system schematics and Technical Drawings.

D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.5 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.

E. Install cables without damaging conductors, shield, or jacket.

F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

3.6 CABLE APPLICATION

A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).

D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).

E. Card Readers and Keypads:

1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.

4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 500 feet (150 m).

G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet (8 m).

3.7 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.8 INSTALLATION

A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered, and installed.

B. Components shall be configured with appropriate “service points” to pinpoint system trouble in less than 30 minutes.

C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.

D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.

E. For integration purposes, the PACS shall be integrated where appropriate with the following associated security subsystems:

1. CCTV:

a. Provide 24-hour coverage of all entry points to the perimeter and agency buildings. As well as all emergency exits utilizing a fixed color camera.
b. Be able to monitor, control and record cameras on a 24-hour basis.
c. Be programmed automatically call up a camera when an access point is but into an alarm state.
d. For additional PACS system requirements as they relate to the CCTV, refer to Section 28 23 00, VIDEO SURVEILLANCE.

2. IDS:
   a. Be able monitor door control sensors.
   b. Be able to monitor and control the IDS on a 24-hour basis.
   c. Be programmed to go into an alarm state when an IDS device is put into an alarm state and notify the operator via an audible alarm.
   d. For additional PACS system requirements as they relate to the IDS, refer to Section 28 16 11, INTRUSION DETECTION SYSTEM.
3. Security Access Detection:
   a. Be able to monitor all objects that have been screened with an x-ray machine and be able to monitor all data acquired by the bomb detection unit.
   b. For additional PACS system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.
4. EPPS:
   a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated and notify the Physical Access Control System and Database Management of an alarm event.
   b. For additional PACS requirements as they relate to the EPPS, refer to Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM.

F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.

G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

H. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect

performance of the system. The Contractor shall not take any corrective action without written permission from the Government.

I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

J. Existing Equipment:

1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

M. Control Panels:
   1. Connect power and signal lines to the controller.
   2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.

N. SMS:
   1. Coordinate with the VA agency's IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only authorized VA personnel have access to the system.
   2. Program and set-up the SMS to ensure it is in fully operation.

O. Card Readers:
   1. Connect all signal inputs and outputs as shown and specified.
   2. Terminate input signals as required.
   3. Program and address the reader as per the design package.
   4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

P. Door Status Indicators:
   1. Install all signal input and output cables as well as all power cables.
   2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.

3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2” (5 cm).

Q. Entry Control Devices:

1. Install all signal input and power cables.
2. Strikes and bolts shall be mounted within the door frame.
3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the maglock mounted to the door frame and the metal plate mounted to the door.

R. System Start-Up:

1. The Contractor shall not apply power to the PACS until the following items have been completed:
   a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
   b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   c. System wiring has been tested and verified as correctly connected as indicated.
   d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
   e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
3. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

S. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.

2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.9 SYSTEM SOFTWARE

A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
C. Perform the following field tests and inspections and prepare test reports:
   1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
   2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
   3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.13 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

C. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

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SECTION 28 13 53
SECURITY ACCESS DETECTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide and install a complete Detection and Screening System, hereinafter referred to as the Security Access Detection as specified in this section.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.

C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.

D. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.

E. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

F. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

G. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

H. Section 28 08 00 - COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. For commissioning requirements, systems readiness checklists, and training.

I. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.

L. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

1.3 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the Security Access Detection as shown. The Contractor shall also provide certification as required.

B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

E. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.4 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

B. Provide certificates of compliance with Section 1.3, Quality Assurance.

C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (in.) (1220 x 1220 millimeters) (mm); drawing submittals shall be per the established project schedule.

D. Pre-installation design and as-built packages shall include, but not be limited to:

1. Index Sheet that shall:
   a. Clearly define each page of the design package to include facility name, building name, floor, and sheet number.
   b. Provide a complete list of all security abbreviations and symbols.
   c. Reference all general notes that are utilized within the design package.
   d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      1) Outline all general and job specific work required within the design package.
      2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
   a. Include a title block as defined above.
   b. Clearly define the drawings scale in both standard and metric measurements.
   c. Provide device identification and location.

d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements.
e. Identify all pull box and conduit locations, sizes, and fill capacities.
f. Address all general and drawing specific notes for a particular drawing sheet.

3. A detailed riser drawing for each applicable security subsystem shall:
   a. Indicate the sequence of operation.
   b. Relationship of integrated components on one (1) diagram.
   c. Include the number, size, identification, and maximum lengths of interconnecting wires.
   d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
   a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
   b. Provide full detail of all system components wiring from point-to-point.
   c. Identify wire types utilized for connection, interconnection with associate security subsystems.
   d. Show device locations that correspond to the floor plans.
   e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).
   c. Mounting type (e.g. flush, wall, surface, etc.).
   d. Power supply or circuit breaker and power panel number.
   e. In addition, provide the Security Access Detection detector or screening device ID, type (e.g. walk-through screener, X-ray, explosive detector, etc.), type of technology used by system for detection and model number.
6. Provide detail and elevation drawings for all devices that define how they were installed and mounted.

E. The pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
   1. 35 percent
   2. 65 percent
   3. 90 percent
   4. 100 percent

F. The Contractor shall provide manufacturer security system product cut-sheets that clearly and completely indicate the description and function of each component of the security systems they are associated with. Also, indicate all termination points of devices and interconnections required for operation of the system, and between modules and devices.

G. The Contractor shall submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include detailed procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

H. The Contractor shall submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing for all security system devices, power sources, control panels, and monitoring equipment.

I. The Contractor shall provide complete maintenance and operating manuals from the manufacturer that support as-builts and system design, to include all technical product sheets and overall system schematics. Two (2) weeks prior to the final inspection, four (4) copies of the maintenance and operating manuals also need to be submitted to the RE.

J. Certifications: Two (2) weeks prior to final inspection, submit four (4) copies of the following to the RE:
   1. Complete maintenance and operating manuals from the manufacturer that support as-built and systems design, to include all technical data sheets and overall system schematics.
   2. Certification by the Contractor that the materials submitted is in accordance with the drawings and specifications.
   3. Certification by the Contractor that a complete security system installation has been installed, tested and adjusted.

K. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in

accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM)

C1238-97 (R03) .....Standard Guide for Installation of Walk-Through Metal Detectors

C. Department of Justice American Disability Act (ADA)

28 CFR Part 36-94.....ADA Standards for Accessible Design

D. Department of Veterans Affairs

VHA National CAD Standard Application Guide, 2006

VA BIM Guide, V1.0 10

E. Federal Communications Commision (FCC):

(47 CFR 15) Part 15 .....Limitations on the Use of Wireless Equipment/Systems

F. Government Accountability Office (GAO):

GAO-03-8-02 .....Security Responsibilities for Federally Owned and Leased Facilities

G. Institute of Electrical and Electronics Engineers (IEEE):

C95.1-05 .....Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields

H. National Fire Protection Association (NFPA):

70-11 ..... Article 780-National Electrical Code

I. National Institute of Justice (NIJ)

0601.02-03 .....Standards for Walk-Through Metal Detectors for use in Weapons Detection

0602.02-03 .....Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection

J. National Electrical Manufactures Association (NEMA)

250-08 .....Enclosures for Electrical Equipment (1000 Volts Maximum)

K. Occupational and Safety Health Administration (OSHA):

29 CFR 1910.97 .....Nonionizing radiation

L. Security Industry Association (SIA):

AG-01 .....Security CAD Symbols Standards

M. Underwriters Laboratories, Inc. (UL):

187-98 .....Standard for X-ray Equipment

464-03 .....Audible Signal Appliances

N. United States Department of Commerce:

Special Pub 500-101 .....Care and Handling of Computer Magnetic Storage Media

O. Uniform Federal Accessibility Standards (UFAS), 1984

P. Architectural Barriers Act (ABA), 1968

1.6 COORIDNATION

A. Coordinate arrangement, mounting, and support of security access detection equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.7 WARRANTY OF CONSTRUCTION.

A. Warrant Security Access Detection work subject to the Article “Warranty of Construction” of FAR clause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

PART 2 – PRODUCTS

2.1 GENERAL

A. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 hertz (Hz) or 60 Hz alternating current (AC) power system unless documented otherwise in subsequent sections listed within this spec. All equipment shall have a battery back-up source of power that will

provide 12 hours (hrs.) of run time in the event of a loss of primary power to Security Access Detection systems until a backup generator comes on-line.

B. Walk-through metal detectors and X-ray machines shall meet the National Institute of Justice (NIJ) Standards and Safety requirements.

C. The Security Access Detection shall be designed, installed, and programmed in a manner that will allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.

D. All Security Access Detection components located in designated “HAZARDOUS ENVIRONMENT” areas where fire or explosion could occur due to the presence of natural gases or vapors, flammable liquids, combustible residue, or ignitable fibers or debris, shall be rated Class II, Division I, Group F, and installed in accordance with NFPA 70, Chapter 5.

E. All Security Access Detection equipment and materials provided shall be new, first grade, standard, current products of the manufacturer and shall be suitable for the systems being installed and the intent of the design.

F. All Security Access Detection equipment and materials shall be stored, adequately protected and carefully handled to prevent damage before and during installation and according to manufacture’s instructions.

G. All Security Access Detection equipment provided with a factory finish shall be maintained free of dust, dirt and foreign matter. Dents, marred finishes and other damage shall be repaired to its original condition or shall be replaced, at no additional cost to the Owner.

H. The Contractor shall provide the RE with written verification, that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of NFPA 70 (NEC). The Contractor is responsible for providing the correct protection cable duct and/or conduit and wiring.

I. The Contractor is responsible for interfacing Security Access Detection with other security subsystems. The Contractor shall utilize interfacing methods that are approved by the OEM and RE. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection; but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein.

J. The characteristics listed in this section will serve as a guide in selection of equipment and materials for the Security Access Detection. If updated or more suitable versions are available then the RE will approve the acceptance of prior to an installation.

K. If any obsolete, incompatible, or damaged equipment is offered by the Contractor at the time of installation, then the equipment will be returned and replaced with equipment at no cost to the government.

2.2 EQUIPMENT ITEMS

A. General

1. All specifications listed within this section are the minimum requirements to be met to ensure a working Security Access Detection is in place.
2. Detection Sensor subsystems shall consist of sensors capable of:
   a. Locating and identifying prohibited, threatening, contraband materials and items the system is designed to detect and protect against being brought into a facility.
   b. Sensors shall be adjustable to maximize capabilities based on environmental and security requirement changes.
3. Annunciation: Shall contain one (1) or more indicator lamps, alphanumeric displays that provide status information about a circuit or condition of the operating units. Walk-Through or conveyer pass through units must provide a uniform two-digit error code to identify different types of system failures.
4. Audible Signal Device: Shall consist of audible sound for alarms, supervisory, and trouble signals and shall be distinctive.
5. Assessment: Shall consist of electronic devices required to visually and audibly verify the validity and functionality of Security Access Detection. Assessment also includes providing indication of tampering, fail-safe, low battery, and power losses.
6. Alarm Reporting: Shall consist of electronic devices to annunciate Security Access Detection information to at least two (2) separate locations. The alarms shall maintain the capability to respond with local and remote visible and audible signals upon activation of detection sensors. The alarms should have the capability of a silent mode only alerting personnel using the system.
7. Power Supply: Security Access Detection shall be capable of continuous operation and include a battery backup module capable of 12 hrs. of backup use. All non-portable systems

shall operate on 100-240 VAC. Hand-Held Security Access Detection (Metal and Explosive Detectors) shall have the capability to operate on rechargeable batteries.

2.3. WALK-THROUGH METAL DETECTORS:

A. Shall meet NIJ Standard 0601.02 and be able to detect and locate guns, knives, and other flat and rod-shaped objects regardless of orientation.

B. All electronics shall be modular in design for easy plug-in and replacement. The Detector shall use multiple coil circuits with dual alarm lights to indicate which side of the individual the detected item is located.

C. Shall be capable of self-diagnostics and conduct self-test of all systems to automatically identify failures or problems with components as displayed on the control unit liquid crystal display (LCD). The detection unit shall not require re-calibration each time the system is turned off and back on.

D. Shall provide for full body coverage: coverage on the left, center, right, front, and back of the body from head to floor, providing uniform detection.

E. Shall include individual zones that are adjustable for customization of detection characteristics and/or compensation for metallic environmental challenges.

F. Shall have the capability to detect and discriminate signals from two (2) or more detectable items located in close proximity that may be detected as only one (1).

G. Shall include adjustable legs to provide for accurate leveling on uneven floors.

H. Major components include:

1. Walk-through portal/passage way
2. Control Unit
3. Test Unit

I. Technical Characteristics:

Operating Temperatures	-4°F (-20°C) to 158°F (70°C) 95% humidity non-condensing
Power Supply Unit	Fully automatic input 100 to 240 VAC 50 or 60 Hz – five (5) watts Uninterrupted Power supply (UPS) Battery Backup (12 hours)
Construction	Minimum 3/32 in. (2.381mm) aluminum in strength and weather resistant
Opening Sizes	Interior Width: 30 in. (762mm) Interior Height: 80 in.(2.032 meters)

Programmable	Capable of 16 independent programs settings for zones and sensitivity
Sensitivity Boost	Three (3) levels at ankle level
Detection Sensors	Multi-dimensional coil 33 distinct pin-point zones – customizable
Sensitivity Levels	200
Interference Protection	Faraday shielding
Alarms	Audible and light-emitting diode (LED) Visual
Testing Device	Simulate size, shape, and composition of threat objects meet FAA testing requirements
Traffic Flow Indicators	LED Lights
Infrared Sensor	Traffic control and counter

J. Control Unit: Shall consist of the components to constantly monitor, input settings, and verify inputs of sensors.

1. The control unit is to be attached to the exit side of the scanner or shall be able to be detached and operational from up to 50 feet (ft.) (15.24 meters)(m) from detector.
2. The control unit will consist of a multiple functional electronic digital keypad/touchpad. The keypad/touchpad requires human/machine interface (HMI) with numerical or function keys that can activate, deactivate, observe or change sensitivity and detector settings using secure codes.
3. The Control Unit shall be programmed to be self-prompting for input.
4. The LCD display shall be large, easily seen, backlit with alpha-numeric display that reports in words to regulate, control and provide self-prompt functions of the control unit.
5. Control Unit Technical Characteristics:

Display	LCD
Connection to Unit	Wired with extension of 50 ft. (15.24m) for remote use
Touchpad Controls	Operate, Off, Counter, Volume, +/-, Program and Access
Displays	LED bar-graphs for detection sensitivity Alarm lights Functionality Program in operation Errors Traffic Count Alarm activations Alarm Percentages
Tamper alarm	10 seconds after access of touchpad

Access Control	Dual-level access codes for: Operators Supervisors

K. Control Unit Interface:

1. The system shall include an interface module for network transmission of data and remote monitoring of system at the Physical Access Control System and Database Management.
2. Integration with the Physical Access Control System and Database Management shall allow for control, real time monitoring and diagnostics capabilities.
3. Control Unit Interface Technical Characteristics:

Display	LCD (laptop or Desktop Monitor)
Connection	10-Base T Network
System Capabilities	Monitor up to 4 scanners
Capabilities	Change settings LED bar-graph display Functionality Program in operation Errors Traffic Count Alarm activations Alarm Percentages Technician trouble-shoot
Access Control	Dual-level access codes Operators Supervisory

2.4. HAND-HELD METAL DETECTORS:

A. Shall meet NIJ Standard 0602.02 and be rugged in design and water-proof; lightweight to reduce stress of handling; and provide ease of freedom of movement and control.

B. Shall be easily made operational with a one (1) switch operation that does not require any adjustments.

C. Technical Characteristics:

Operating Temperatures	-35°F (-37°C) to 158°F (70°C) 95% humidity non-condensing
Operating Frequency	93 kHz
Audio Frequency	2kHz Warble Earphone capable
Tuning	Automatic
Controls	Power switch On/Off Interference Elimination
LED Alert Lights	Power On, Battery Low, Alarm
Indicators	Silent/Vibrate Audible Speaker

	LED Alert Lights
Power	Standard 9 volt and Nickel-Metal Hydride(NiMH)rechargeable battery
Battery life	60 hours continuous operations
Minimum Detection Capability Distances	Medium Pistol – 9 in. (228.6mm) Large Knife- 5 in. (127mm) Razor Blade- 3 in. (76.2mm) Small foil and jewelry – 1 in.

2.5 X-RAY DETECTORS:

A. Shall be surface mounted, multilayer, fully integrated, high frequency, and solid state using high speed processors.

B. Shall meet NIJ Standards including a Personal Computer (PC) based system that can be networked with other inspection systems and can transmit data.

C. The type of X-ray unit selected shall require consideration of its application and use (i.e., used to screen items through lobby control points versus screening items, which may be larger in size, such as through mail room/shipping and receiving facility areas).

D. The system should provide the capability to send images through a network to a central server PC where the images can be viewed, stored or printed.

E. The conveyer belt system belts should be guaranteed to perform auto tracking for life.

F. All x-ray systems shall be certified to be in full compliance with all international radiation safety requirements and external emissions limits.

G. Technical Characteristics:

X-Ray Generator	Self Contained operating at 90 kilovolts
Controls	Edge sharpening, variable intensity control, zoom, atomic number measurement
Zoom Capability	2X to 32X penetration levels
Discrimination	Organic, inorganic, mixed
Penetration	0.39 in. (10 mm) steel
Resolution capability	Detect #40 AWG
Color Tones	Two (2) million (Multi-Energy Colors)
Conveyer belt weight capabilities	200 lbs. (90 kilograms)
Conveyer belt speed	Controllable – 48 fpm (24 cm/sec)- reversible
Network Capable	Ethernet using TCP/IP

H. Central Processing Unit Technical Characteristics:

Processor	2.4 GHz Intel Pentium IV
Hard Disk Size	40 GB
Memory	256 RAM
Network Card	10/100 Base-T
CD-ROM Drive	10X
Monitor/Video Adapter board	19” (482.6mm)SVGA (1280 x 1044)Flicker Free Flat Screen .28 dot pitch
Floppy Drive	1.44 MB
Ports	2 serial, 1 parallel, USB
Backup	Tape or CDRW

2.6 EXPLOSIVES DETECTORS:

A. Handheld: Provide for a self-contained analytical unit, with on-board computer, printer and touch screen display. The detector shall be easy to operate by non-technical staff/operators:

1. System will use dual vapor and particulate detection without any external carrier gas or radioactive source.
2. Detector shall be a simple push-button automatic operation that displays go/no go results on a LCD display.
3. Explosive Detectors Technical Characteristics:

Power	12 volt direct current (DC) rechargeable 12 volt External battery pack 12 volt AC adapter
Device Controls	Power switch, keypad, automatic vapor/particulate selector, volume control (with optional earphone, and sample switch.
Memory	Store a minimum of 1000 previous readings
Detection	Dual vapor and particulate
Detection Analysis	<20 seconds
Detection Capabilities	Nanogram levels of: C-4, TNT, Dynamite, PETN, Semtex, EGDN, DMNB, RDX, ANFO, Black Powder, Ammonium Nitrate, Urea Nitrate, Nitroglycerine and TATP

B. Desktop:

1. Shall have a built-in networking and communication capability. The device shall easily interface with other screening systems and printer if it is not part of the unit.
2. Shall be self-contained, self-cleaning, self-calibrating, and require no external gas supply.

3. A touch screen display shall be provided that displays both alarm and compound identification information Red flashing light on unit and audible alarm Automatic "Print on Alarm" option.
4. Contractor shall provide collection device for input of data.
5. Technical Characteristics:

Power	90 to 265 volts alternating current (VAC) 50-60 Hz
Technology	Dual- gas chromatography and Ion mobility spectrometer
Power Consumption	Less than 500 watts
Device Controls	Touch screen display Power switch
Operating Modes	Continuous and Single Cycle
Warm up time	< 20 minutes (cold start)
Memory	Store a minimum of 1000 previous readings
Detection	Dual vapor and particulate
Analysis Time	< 20 seconds
Detection Capabilities	Nanogram levels of: 1) Explosives: PETN, RDX,TNT, NG, Dynamite, Semtex, C4 2) Narcotics: Cocaine, Opiates (heroine & morphine), Cannabis marijuana & hashish), Amphetamine-type stimulants amphetamine, ecstasy & methamphetamine.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation shall be in accordance with appropriate NEC, UL, NFPA, Related Work VA specifications, and appropriate installation manual for each type of Security Access Detection.

B. The Security Access Detection system will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.

C. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.

D. All Security Access Detection requiring VAC connection will be installed with surge protection and Uninterrupted Power Supply (UPS).

E. Architectural space planning design requirements need to be considered and defined prior to the installation of metal detection, x-ray and explosive detection equipment at main lobby entrance or other security control points. This also applies to the use of x-ray and explosive detectors in mail and shipping/receiving facility areas.

F. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

G. Walk-through metal detectors will not be located on floors with high metal content that may interfere with screening without protection between the floor and detector being considered.

H. The Contractor shall provide walk-through metal detectors with the capability for floor mounting (OEM recommended brackets) to increase stability.

3.2 WIRING

A. Wiring Method: Install cables in raceways[except in accessible indoor ceiling spaces, in attics,] [in hollow gypsum-board partitions,] and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

B. Wiring Method: Install cables concealed in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

C. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Remove and replace malfunctioning items and retest as specified above.

F. Record test results for each piece of equipment.

G. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of detectors.
3. Recommend changes to walk trough detectors, X-ray machines, and associated equipment to improve Owner' utilization of security access detection system.
4. Provide a written report of adjustments and recommendations.

B. Adjustment/Alignment/Synchronization: Contractor shall prepare for system activation by following manufacturer’s recommended procedures for adjustment, alignment, programming, or synchronization. Prepare each component in accordance with appropriate provisions of the component’s installation, operations, and maintenance instructions.

3.5 CLEANING

A. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.

3.6 INTEGRATION

A. For integration purposes, the Security Access Detection system shall be integrated with the Physical Access Control System and Database Management via CAT-V cables and where appropriate with CCTV and EPPS. The CCTV Security System will:

1. Provide full coverage of all lobby entrance screening areas utilizing a fixed color camera.

2. Record activity on a 24 hours basis.
3. The CCTV system should have facial recognition software to assist in identifying individuals for current and future purposes.
4. For additional CCTV system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.

B. Integration with CCTV and EPPS security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.

C. For programming purposes, refer to the manufacturers requirements for correct system operations. Ensure computer hardware being utilized for system integration meets or exceeds the minimum system requirements as well as systems software requirements.

3.7 EXISTING CONDITIONS

A. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

B. Existing Equipment

1. The Contractor shall connect to and utilize existing equipment, and control signal transmission lines, and devices as outlined in the design package. Equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
2. The Contractor shall perform a field survey, including testing and inspection of all existing equipment, power outlets, and signal lines intended to be used by the Security Access Detection, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after

the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.

4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
5. The Contracting Officer shall provide a full list of all equipment that is to be removed or replaced by the Contractor. The Contractor shall dispose of all equipment that has been removed or replaced. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

3.8 SYSTEM START-UP AND TESTING

A. System Start-Up
   1. The Contractor shall not apply power to any installed Security Access Detection until the following items have been completed:
      a. Security Access Detection equipment items have been set up in accordance with manufacturer's instructions.
      b. A visual inspection of the Security Access Detection system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
      c. System wiring has been tested and verified as correctly connected as indicated.
      d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
      e. Power supplies to be connected to the Security Access Detection system have been verified as the correct voltage, phasing, and frequency as indicated by the manufacturer.
   2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

B. Supplemental Contractor Quality Control: The following requirements supplement the Contractor quality control requirements specified elsewhere in the contract:
   1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of any installed Security Access Detection; and are approved by the Contracting Officer.

2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

C. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.9 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

-----END----

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide and install a complete Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.

B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and camera mounts.

C. Video surveillance system Video assessment & surveillance system shall be integrated with monitoring and control system specified in Division 28 Section PHYSICAL ACCESS CONTROL that specifies systems integration.

1.2 RELATED WORK

A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.

B. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system integration.

1.3 DEFINITIONS

A. AGC: Automatic gain control.

B. B/W: Black and white.

C. CCD: Charge-coupled device.

D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).

E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).

F. H.264 (also known as MPEG4 Part 10): a encoding format that compresses video much more effectively than older (MPEG4) standards.

G. ips: Images per second.

H. MPEG: Moving picture experts' group.

I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.

J. NTSC: National Television System Committee.

K. UPS: Uninterruptible power supply.

L. PTZ: refers to a movable camera that can pan left and right, tilt up and down, and zoom or magnify a scene.

1.4 QUALITY ASSURANCE

A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System components as shown. The Contractor shall also provide certification as required, showing that they are an authorized provider of the manufacturer's equipment.

B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.

C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

D. Manufacturers' Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project and shall have manufactured the item for at least three years.

E. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of the

system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 SUBMITTALS

A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples.
B. Provide certificates of compliance with Section 1.4, Quality Assurance.
C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
D. Pre-installation design and as-built packages shall include, but not be limited to:
   1. Index Sheet that shall:

a. Define each page of the design package to include facility name, building name, floor, and sheet number.
b. Provide a list of all security abbreviations and symbols.
c. Reference all general notes that are utilized within the design package.
d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
    1) Outline all general and job specific work required within the design package.
    2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.

2. Floor plans, site plans, and enlarged plans shall:
    a. Include a title block as defined above.
    b. Define the drawings scale in both standard and metric measurements.
    c. Provide device identification and location.
    d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    e. Identify all pull box and conduit locations, sizes, and fill capacities.
    f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
    a. Indicate the sequence of operation.
    b. Relationship of integrated components on one diagram.
    c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = category 6A UTP 4 pair 24 AWG). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
    a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    b. Provide full detail of all system components wiring from point-to-point.
    c. Identify wire types utilized for connection and interconnection with associate security subsystems.
    d. Show device locations that correspond to the floor plans.

e. All general and drawing specific notes shall be included with the system drawings.

5. A schedule for all the applicable security subsystems shall be included. All schedules shall provide the following information:
   a. Device ID.
   b. Device Location (e.g. site, building, floor, room number, location, and description).
   c. Mounting type (e.g. flush, wall, surface, etc.).
   d. Power supply or circuit breaker and power panel number.
   e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
6. Detail and elevation drawings for all devices that define how they were installed and mounted.

E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
   1. 35 percent
   2. 65 percent
   3. 95 percent
   4. 100 percent

F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

H. Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330-09 ..... Electrical Performance Standards for CCTV Cameras

375A-76 ..... Electrical Performance Standards for CCTV Monitors

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41-02 ..... IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

802.3af-08 ..... Power over Ethernet Standard

D. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Contractors Association (NECA):

303-2005 ..... Installing Closed Circuit Television (CCTV) Systems

F. National Fire Protection Association (NFPA):

70-08 ..... Article 780-National Electrical Code

G. Federal Information Processing Standard (FIPS):

140-2-02 ..... Security Requirements for Cryptographic Modules

H. Underwriters Laboratories, Inc. (UL):

983-06 ..... Standard for Surveillance Camera Units

3044-01 ..... Standard for Surveillance Closed Circuit Television Equipment

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of video surveillance equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. Connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

1.8 WARRANTY OF CONSTRUCTION

A. Warrant VASS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

PART 2 – PRODUCTS

2.1 GENERAL

A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

C. Power Connections: Comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2, as recommended by manufacturer for type of line being protected.

D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 CAMERAS

A. All Cameras will be EIA 330 and UL 1. Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.

B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:

1. Will be a charged coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.

2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and are to be utilized to complement the fixed cameras.
3. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.

5. Each function and activity shall be addressed within the system by a unique user-defined name, with a minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
6. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
7. Dummy or fake cameras will not be utilized at any time.
8. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

2.3 Camera License

1. Camera License
   a. To connect to a camera, a Device License per camera channel is required
   b. In total, for all copies of the product installed under a given Base Server license, the product may only be used with as many cameras as you have purchased camera licenses for.
   c. Camera Licenses can be purchased in any numbers. To extend the installation with additional Camera Licenses, the Base Server License number (SLC) is required when ordering.

2.4 VIDEO CAMERAS

A. The cameras shall be high-resolution color video cameras with wide dynamic range capturing capability.
B. The camera shall meet or exceed the following specifications:

1. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
    a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
    b. The image capturing device shall sample each pixel multiple times per second.
    c. The dynamic range shall be 95 dB typical and 120 dB maximum.
3. The camera shall optimize each pixel independently.
4. The camera shall have onscreen display menus for programming the camera's settings.
5. The signal system shall be NTSC.

A. The camera shall have composite video output.

B. The camera shall come with a manual varifocal lens.

C. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.

D. Fixed Color Camera
1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. Comply with UL 639.
3. Pickup Device: 1/3 CCD interline transfer.
4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
5. With AGC, manually selectable on or off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.
8. Fixed color camera shall be enclosed in dome and have board mounted varifocal lens.
9. Camera accessories shall include:
    a. Surface mount adapter
    b. Wall mount adapter
    c. Flush mount adapter
    a. Pendant mount
    b. Wall mount for pendant
    c. Corner adapter for wall mount
    d. Pole adapter for wall mount

S. Megapixel High Definition Integrated Digital Network Camera

1. The network camera shall offer dual video streams with up to 3.1-megapixel resolution (2048 x 1536) in progressive scan format.
2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black, white (B-W).
7. The network camera shall have a removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
8. The network camera shall support two simultaneous, configurable video streams. H.265 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
9. The network camera shall support industry standard Power over Ethernet (PoE)
10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
13. The network camera shall support standard IT protocols.
14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.
15. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms)0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.265 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution, and stream configuration
Available Resolutions	3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264 2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264 1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264 1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max.,10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264

	0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max.,1.6 Mbps bit rate H.264 0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264 Additional640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP,IPv4, SNMP, QoS, HTTP, HTTPS, LDAP (client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat 6A cable for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

16. Accessories
    a. Pendant mount
    b. Wall mount for pendant
    c. Corner adapter for wall mount
    d. Pole adapter for wall mount

17. Recommended Lenses

a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

T. Indoor/Outdoor Camera Dome System

1. The indoor/outdoor camera dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The indoor/outdoor camera dome system shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor VASS camera dome system shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360° rotation; 1/4-inch high resolution color, or color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus; and an enclosure consisting of a back box, lower dome, and a quick-install mounting.
4. Indoor/Outdoor fixed dome system technical specifications:

Imaging Device	1/4-inch CCD
Picture Elements	NTSC/PAL 768 x 494/752 x 582
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace
Synchronization	Internal
Electronic Shutter Range	Auto (1/15–1/22,000)
Lens Type	Lens f/1.4 (focal length, 3.4~119 mm; 35X optical zoom, 12X digital zoom)
Focus	Automatic with manual override
Pan Speed	Variable between 400° per second continuous pan to 0.1° per second
Vertical Tilt	Unobstructed tilt of +2° to -92°
Manual Control Speed	Pan speed of 0.1° to 80° per second and pan at 150° per second in turbo mode. Tilt operation shall range from 0.1° to 40° per second
Automatic Preset Speed	Pan speed of 400° and a tilt speed of 200° per second

Presets	256 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, Low Light™ limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu 128 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, Low Light limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu
Preset Accuracy	± 0.1°
Zones	8 zones with up to 20-character labeling for each, with the ability to blank the video in the zone
Limit Stops	Programmable for manual panning, auto/random scanning, and frame scanning
Alarm Inputs	7
Alarm Output Programming	Auxiliary outputs can be alternately programmed to operate on alarm
Alarm Action	Individually programmed for 3 priority levels, initiating a stored pattern or going to a preassigned preset position
Resume after Alarm	After completion of alarm, dome returns to previously programmed state or its previous position
Window Blanking	8, four-sided user-defined shapes, each side with different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle
Patterns	8 user-defined programmable patterns including pan/tilt/zoom and preset functions, and pattern programming through control

	keyboard or through dome system on-screen menu
Scheduler	Internal scheduling system for programming presets, patterns, window blanks, alarms, and auxiliary functions based on internal clock settings
Auto Flip	Rotates dome 180° at bottom of tilt travel
Password Protection	Programmable settings with optional password protection
Compass Display	On-screen display of compass heading and user-definable compass setup
Camera Title Overlay	20 user-definable characters on the screen camera title display
Video Output Level	User-selectable for normal or high output levels to compensate for long video wire runs
Motion Detection	User-definable motion detection settings for each preset scene, can activate auxiliary outputs, and contains three sensitivity levels per zone
Electronic Image Stabilization	Electronic compensation for external vibration sources that cause image blurring; user selectable for 2 frequency ranges, 5 Hz (3-7 Hz) and 10 Hz (8-12 Hz)
Wide Dynamic Range	128X
Video Output	1 Vp-p, 75 ohms
Minimum Illumination	NTSC/EIA 0.55 lux at 1/60 sec shutter speed (color), 0.063 lux at 1/4 sec shutter speed (color), 0.00018 lux at 1/2 sec shutter speed (B-W) PAL/CCIR 0.55 lux at 1/50 sec shutter speed (color), 0.063 lux at 1/3 sec shutter speed (color), 0.00018 lux at 1/1.5 sec shutter speed (B-W)
Compression	MPEG-4, MJPEG
Video Streams	3, simultaneous
Video Resolutions	NTSC PAL 4CIF 704 x 480 704 x 576 2CIF 704 x 240 704 x 288 CIF 352 x 240 352 x 288

	QCIF 176 x 120 176 x 144
Bit Rate	Configurable, MPEG-4 30 ips, 2 Mbps for primary stream, MJPEG 15 ips, 3 Mbps, MJPEG
Web User Interface	
Environment	Low temperature, indoor/outdoor
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X
Cabling	CAT 6A cable for 100BASE-TX
Input Voltage	18 to 32 VAC; 24 VAC nominal 22 to 27 VDC; 24 VDC nominal
Power Consumption	24 VAC 23 VA nominal (without heater);73 VA nominal (with heater) 24 VDC 0.7 A nominal (without heater);3 A nominal (with heater)
Alarm Input	7
Alarm Output	1
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

5. Accessories
   a. Pendant mount
   b. Wall mount for pendant
   c. Corner adapter for wall mount
   d. Pole adapter for wall mount

U. Reinforced Fixed Dome Camera
1. The dome camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. The camera shall meet or exceed the following specifications:
   a. The camera shall have the form factor as typical of a traditional VASS dome video camera.
   b. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
3. The camera shall optimize each pixel independently.

4. The camera shall have onscreen display menus for programming the camera's settings.
5. The signal system shall be NTSC or PAL selectable.
6. The sensitivity shall be 0.6 lux at f1.2, 30 IRE.
7. The signal-to-noise ratio shall be 50 dB.
8. The electronic shutter shall have automatic adjustment, and operate from 1/60 NTSC to 1/100,000 second, automatic.
9. The camera shall have an automatic white balance range of 2800 to 11000 K.
10. The camera shall have automatic gain control.
11. The camera shall include a shroud to conceal the camera's position inside the dome.
12. The housing shall have the following specifications:
    a. The housing shall be heavy duty and tamper resistant.
    b. Dome housing construction: 0.13-in polycarbonate.
    c. Finish: Powder coat
13. The camera shall come with a manual varifocal 4 to 9 mm lens.
14. The environmental specifications for the camera shall be as follows: Operating temperature shall be -10 to 45 degrees Celsius or 14 to 113 degrees Fahrenheit.
15. Accessories shall include:
    a. Surface mount adapter
    b. Wall mount adapter
    c. Flush mount adapter

V. Indoor/Outdoor Fixed Mini Dome System

1. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)

Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace (progressive option on CW/DW models only
Synchronization	Internal
Electronic Shutter Range	Auto (1/15–1/22,000)
Lens Type	Varifocal with auto iris
Format Size	1/3-inch
Focal Length	3.0 mm–9.5 mm 9.0 mm–22.0 mm <list>
Operation	Iris Auto (DC-drive) Focus Manual Zoom Manual
Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)
Compression	H.265, MJPEG in Web viewing mode
Video Streams	3, simultaneous
Video Resolutions	NTSC PAL 4CIF 704 x 480 704 x 576 2CIF 704 x 240 704 x 288 CIF 352 x 240 352 x 288 QCIF 176 x 120 176 x 144
Bit Rate	Configurable, 20 kbps to 2 Mpbs per stream
Web User Interface	
Environment	Low temperature, indoor/outdoor
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X
Cabling	CAT 6A cable for 100BASE-TX
Input Voltage	24 VAC (18-36) or PoE input voltage
Power Consumption	<7.5 Watts, <13 Watts with heaters

	24VAC: <0.5 Amps, <0.9 Amps with heaters
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)
Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°
Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

4. Accessories
   a. Pendant mount
   b. Wall mount for pendant
   c. Corner adapter for wall mount
   d. Pole adapter for wall mount

W. Megapixel High Definition Integrated Digital Network Camera
1. The network camera shall offer dual video streams with up to 3.1-megapixel resolution (2048 x 1536) in progressive scan format.
2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black, white (B-W).

7. The network camera shall have a removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
8. The network camera shall support two simultaneous, configurable video streams. H.265 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
9. The network camera shall support industry standard Power over Ethernet (PoE)
10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
13. The network camera shall support standard IT protocols.
14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.

X. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms)0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss

	Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution, and stream configuration
Available Resolutions	3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264 2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.265 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264 1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max.,10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264 1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max.,10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264 0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max.,1.6 Mbps bit rate H.264 0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264 Additional640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP,IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras

Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat 6A cable for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

1. Accessories
   a. Pendant mount
   b. Wall mount for pendant
   c. Corner adapter for wall mount
   d. Pole adapter for wall mount
2. Recommended Lenses
   a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
   b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
   c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
   d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

Y. NETWORK CAMERAS

1. Shall be IEEE 802.3af compliant.
   a. Shall be utilized for interior and exterior purposes.
   b. A Category 6A cable will be the primary source for carrying signals up to 100 m (300 ft.) from a switch hub or network server. If any camera is installed greater than 100 m (300 ft.) from the controlling device then the following will be required:
      1) A local or remote 12 VDC or 24 VAC power source will be required from a Class 2, UL compliant power supply.

2) A signal converter will be required to convert from a CAT 6A cable over to a fiber optic or standard signal cable. The signal will need to be converted back to a CAT 6A cable at the controlling device using a signal converter card.

c. Shall be routed to a controlling device via a network switch.

e. Shall be a programmable IP address that allows for installation of multiple units in the same Local Area Network (LAN) environment.

d. Incorporate a minimum of Transmission Control Protocol (TCP)/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Internet Control Message Protocol (ICMP0, Address Resolution Protocol (ARP), Real-Time Transport Protocol (RTP), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Simple Mail Transfer Protocol (SMTP), Internet Group Management Protocol (IGMP), and Differentiated Service Code Point (DSCP) protocols for various network applications.

Z. Fixed Network Camera

1. The fixed network camera shall have following technical characteristics:

Video Standards	MPEG-4; M-JPEG, H.265
Video Data Rate	9.6 Kbps - 6 Mbps Constant & variable
Image Resolution	768x494 (NTSC)
Video Resolution	704 x 576/480 (4CIF: 25/30 IPS) 704 x 288/240 (2CIF: 25/30 IPS) 352 x 288/240 (CIF: 25/30 IPS) 176 x 144/120 (QCIF: 25/30 IPS)
Select Frame Rate	1-25/30 IPS (PAL/NTSC); Field/frame-based coding
Network Protocols	RTP, Telnet, UDP, TCP, IP, HTTP, IGMP, ICMP
Software Update	Flash ROM, remote programmable
Configuration	Via web browser, built-in web server interfaces
Video Out	1x Analog composite: NTSC or PAL; BNC connector 75 Ohm
Sensitivity	1 0.65 lux (color) 0.26 lux (Night Sense)
Minimum Illumination	0.30 lux (color)0.12 lux (Night Sense)
Video Signal-to-Noise Ratio	50 dB

Video Signal Gain	21 dB, (max) Electronic Shutter Automatic, up to 1/150000 sec. (NTSC)
Alarm In	Automatic sensing (2500 - 9000 K)
Input Voltage	+5 V nominal, +40 VDC max VDC: 11-36 V (700 mA) VAC: 12-28 V (700 mA) PoE: IEEE 802.3af compliant

2. Camera accessories shall include:
   a. Surface mount adapter
   b. Wall mount adapter
   c. Flush mount adapter

AA. Interior Domes

1. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
2. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more than 1 f-stop.
3. The housing shall be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide a fully functional pan/tilt dome.
4. The pan/tilt mechanism shall be:
   a. Constructed of heavy-duty bearings and hardened steel gears.
   b. Permanently lubricated to ensure smooth and consistent movement of all parts throughout the life of the product.
   c. Equipped with motors that are thermally, or impedance protected against overload damage.
   d. Pan movements shall be 360 degrees and tilt movement shall not be less than +/- 90 degrees.
   e. Pan speed shall be a minimum of 10 degrees per second.

PART 3 - EXECUTION

3.1. GENERAL

A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.

B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labelling format shall be identified, and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by the type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer database or spread sheet. The labels shall be E-Z code WES12112 or equivalent.

   1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing

C. Acceptance Test and Endurance Test: The Category 6A cables shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified. Testing shall conform to TIA and BICSI recommended testing for category 6A cables.

D. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labelling format shall be identified, and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.2 INSTALLATION

A. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

B. The VASS System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.

C. For integration purposes, the VASS System shall be integrated where appropriate with the following associated security subsystems:

1. PACS:
   a. Provide 24-hour coverage of all entry points to the perimeter and agency buildings, as well as all emergency exits utilizing a fixed color camera.
   b. Record cameras on a motion activated basis.
   c. Be programmed to go into an alarm state when an emergency exit is opened and notify the Physical Access Control System and Database Management of an alarm event.
2.
   a. The VASS System should have facial recognition software to assist in identifying individuals for current and future purposes.

D. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

E. Existing Equipment

1. The Contractor shall connect to and utilize existing video equipment.
2. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
3. The Contracting Officer shall be provided with a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

F. Cameras:

1. Install the cameras with focal length lens as indicated for each zone.

2. Connect power and signal lines to the camera.
3. Aim camera to give field of view as needed to cover the alarm zone.
4. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
5. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
6. PTZ cameras shall have all preset positions and privacy areas defined and programmed.

3.3 SYSTEM START-UP

A. The Contractor shall not apply power to the VASS System until the following items have been completed:
   1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
   2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   3. System wiring has been tested and verified as correctly connected as indicated.
   4. All system grounding and transient protection systems have been verified as installed and connected as indicated.

B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage because of Contractor work efforts.

3.4 SUPLEMENTAL CONTRACTOR QUIALITY CONTROL

A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.

B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.

C. The Contractor shall also be available on an as needed basis to aid with follow-up phases of quality control.

D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.6 DEMONSTRATION AND TRAINING

A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, “GENERAL REQUIREMENTS”.

B. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

-----END----

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation to serve the new data center building. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc. The new data center fire alarm system shall be integrated with the existing fire alarm campus system via fiber-optic network cabling. Reference the drawings for additional information.

B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COT or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.

C. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in Building ‘8’, room ‘206’ via the existing fiber loop; fiber loop will extend to the new data center fire alarm control panel from fiber Node 14 and Node 17; reference drawings for additional information.

D. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

A. A fully addressable fire alarm system shall be designed and installed in accordance with the specifications and drawings to serve the new Data Center. Device location and wiring runs

shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

B. Where fire alarm devices are being relocated, Contractor shall relocate existing fire alarm field devices and add fire alarm field devices as indicated on the plans to integrate with the existing system; provide a complete and fully functional fire alarm system

C. Basic Performance:

1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
3. Initiating device circuits (IDC) wiring shall be Class B in accordance with NFPA 72.
4. Signaling line circuits (SLC) wiring shall be Class B in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space.
5. Notification appliance circuits (NAC) wiring shall be Class B in accordance with NFPA 72.
6. Wiring installed in metal raceway within buildings that are protected throughout by sprinklers shall be considered to meet the requirements for Pathway Survivability Level 2 in accordance with NFPA 72(2010) as a 2-hour performance alternative that has been approved by the authority having jurisdiction and shall be permitted for voice communication systems in VA facilities.
7. The building FACP shall monitor common alarm, trouble signals, supervisory signals, and system discharge point from the data center Clean Agent control panel; FACP shall communicate with Clean Agent panel as required. FACP shall annunciate alarm and trouble conditions including detection, pre-discharge alarms, abort switch activation, manual discharge switch, maintenance lock-out, and suppression system alarm. Reference Clean Agent specification 21 22 00 for additional information. The data center shall meet NFPA 75 and provide the following functions:
   i. FACP shall monitor common alarm and trouble signals from the data center Clean Agent control panel; FACP shall communicate with Clean Agent panel as required. FACP shall annunciate alarm and trouble conditions including detection, pre-discharge alarms, abort switch activation, manual discharge switch, maintenance lock-out, and suppression system alarm.

ii. Early detection of smoke and system discharge.

iii. EPO for electrical power for the Information Technology Equipment (ITE).

iv. HVAC Shutdown Switches.

1.3 RELATED WORK

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.

B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.

C. Section 08 71 00 - DOOR HARDWARE. For combination Closer-Holders.

D. Section 21 13 13 - WET-PIPE SPRINKLER SYSTEMS. Requirements for sprinkler systems.

E. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.

F. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

G. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

H. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

I. Section 28 08 00, COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

J. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for integration with physical access control system.

1.4 SUBMITTALS

A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using AutoCAD Release 14 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.

2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COR 3 sets of as-built drawings and one set of the as-built drawing computer files (using AutoCAD 2007 or later) . As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
   b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.

d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.

e. Complete listing of all digitized voice messages.

f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.

g. Include information indicating who will provide emergency service and perform post contract maintenance.

h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.

k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.

2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COR.

a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.

c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.

d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.

e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer’s representative who makes the certification.

2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.

3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

CORCOR1.6 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.

B. National Fire Protection Association (NFPA):

NFPA 13 .....Standard for the Installation of Sprinkler Systems

NFPA 14 ..... Standard for the Installation of Standpipes and Hose Systems

NFPA 20 ..... Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 70.....National Electrical Code (NEC)

NFPA 72.....National Fire Alarm Code

NFPA 90A .....Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 101.....Life Safety Code

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide

E. American National Standards Institute (ANSI):

S3.41 .....Audible Emergency Evacuation Signal

F. International Code Council, International Building Code (IBC)

PART 2 A- PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

B. Campus installed base is Notifier by Honeywell. All fire alarm equipment shall be Notifier by Honeywell.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:

1. All new conduits shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduits shall be 3/4 inch (19 mm) minimum.
4. All raceways shall be red.

B. Wire:

1. Wiring shall be in accordance with NEC article 760, Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.

2. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.
3. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
4. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COR.

2.3 FIRE ALARM CONTROL UNIT

A. General:
1. The existing building fire alarm control panel shall be utilized for system expansion.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Operator terminal at main control unit:
1. Operator terminal shall consist of the central processing unit, display screen, keyboard and printer.
2. Display screen shall have a minimum 15-inch (380 mm) diagonal non-glare screen capable of displaying 24 lines of 80 characters each.
3. Keyboard shall consist of 60 alpha numeric and 12 user/functional control keys.
4. Printer shall be the automatic type, printing the date, time and location for all alarm, supervisory, and trouble conditions.

D. Power Supply:
1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

E. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

F. Supervisory Devices: All sprinkler system valves, standpipe control valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific

location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals. The power supply to the elevator shunt trip breaker shall be monitored by the fire alarm system as a supervisory signal.

G. Trouble signals:
   1. Arrange the trouble signals for automatic reset (non-latching).
   2. System trouble switch off and on lamps shall be visible through the control unit door.

H. Function Switches: Provide the following switches in addition to any other switches required for the system:
   1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
   2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
   3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
   4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
   5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
   6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
   7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
   8. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

I. Remote Transmissions:
   1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
   2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

J. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

K. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of 20 percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

2.4 STANDBY POWER SUPPLY

A. Batteries:

1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Uniform Building Code.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

2.5 ANNUNCIATION

A. Annunciator, Alphanumeric Type (System):

1. Shall be a supervised, LCD display containing a minimum of 2 lines of 40 characters for alarm annunciation in clear English text.

2. Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, waterflow alarm or trouble condition) on the second line.
3. The initial alarm received shall be indicated as such.
4. A selector switch shall be provided for viewing subsequent alarm messages.
5. The display shall be UL listed for fire alarm application.

6. Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the COR.

COR2.6 ALARM NOTIFICATION APPLIANCES

A. Bells:
   1. Shall be electric, single-stroke or vibrating, heavy-duty, under-dome, solenoid type.
   2. Unless otherwise shown on the drawings, shall be 6 inches (150 mm) diameter and have a minimum nominal rating of 80 dBA at 10 feet (3,000 mm).
   3. Mount on removable adapter plates on outlet boxes.
   4. Bells located outdoors shall be weatherproof type with metal housing and protective grille.
   5. Each bell circuit shall have a minimum of 20 percent spare capacity.
B. Speakers:
   1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
   2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.
   3. Four inches (100 mm) or 8 inches (200 mm) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.
C. Strobes:
   1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
   2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
   3. Each strobe circuit shall have a minimum of 20 percent spare capacity.

4. Strobes may be combined with the audible notification appliances specified herein.

D. Fire Alarm Horns:

1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
2. Shall be a minimum nominal rating of 80 dBA at 10 feet (3,000 mm).
3. Mount on removable adapter plates on conduit boxes.
4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
5. Each horn circuit shall have a minimum of 20 percent spare capacity.

2.7 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.
6. Stations identified as key operated only shall have a single standardized lock and key separate from the control equipment.

B. Smoke Detectors:

1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate

the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.

4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Water Flow and Pressure Switches:

1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 12 00, FIRE-SUPPRESSION STANDPIPES and Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

D. Extinguishing System Connections:

1. Each gaseous suppression system shall be monitored for system alarm, supervisory, and trouble conditions via addressable interface devices.

2.8 SUPERVISORY DEVICES

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".

3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.
3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 3/4 inch (19 mm) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
6. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.
7. Fire supervisory signals required by NFPA 20 and monitored by the pump controller shall be provided and monitored by way of address reporting interface devices for the fire pump located indicate location.

2.09 ADDRESS REPORTING INTERFACE DEVICE

A. Shall have unique addresses that reports directly to the building fire alarm panel.

B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.

C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.

D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.

E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.10 SMOKE BARRIER DOOR CONTROL

A. Electromagnetic Door Holders:

1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
2. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.

B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.

C. Door holder control circuits shall be electrically supervised.

D. Smoke detectors shall not be incorporated as an integral part of door holders.

2.11 UTILITY LOCKS AND KEYS:

A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.

B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.

C. All keys shall be delivered to the COR.

2.13 SPARE AND REPLACEMENT PARTS

A. Provide spare and replacement parts as follows:

1. Manual pull stations - 2
3. Heat detectors - 2 of each type
4. Fire alarm strobes - 5
5. Fire alarm bells - 1
6. Fire alarm speakers / strobes - 5
7. Smoke detectors - 2
8. Duct smoke detectors with all appurtenances - 1
9. Sprinkler system water flow switch - 1 of each size
10. Sprinkler system water pressure switch - 1 of each type
11. Sprinkler valve tamper switch - 1 of each type
12. Control equipment utility locksets - 2

13. Control equipment keys - 5
18. Monitor modules - 3
19. Control modules - 3
20. Fire alarm SLC cable (same as installed) – 500 feet (152 m)

C. Spare and replacement parts shall be in original packaging and submitted to the COR.

D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COR.

E. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.13 INSTRUCTION CHART:

Provide typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COR before being posted.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NFPA 70, 72, 75, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.

D. All existing accessible fire alarm conduit not reused shall be removed.

E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.

F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COR.

G. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.

H. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.

I. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.

J. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.

K. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.

L. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.

M. Connect combination closer-holders installed under Section 08 71 00, DOOR HARDWARE.

3.2 TYPICAL OPERATION

A. Activation of any manual pull station, water flow or pressure switch, gaseous suppression system, or smoke detector shall cause the following operations to occur:

1. Operate the emergency voice communication system in Buildings indicate buildings . For sprinkler protected buildings, flash strobes continuously only in the zone of alarm. For buildings without sprinkler protection throughout, flash strobes continuously only on the floor of alarm.
2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Buildings indicate buildings .
3. Release only the magnetic door holders in the smoke zone on the floor from which alarm was initiated after the alert signal.
4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
5. Unlock the electrically locked exit doors within the zone of alarm.

C. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor in that smoke zone . Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters on that floor in that smoke zone .

D. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

E. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.

F. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

3.3 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COR.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.5 INSTRUCTION

A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:

1. Six 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.

B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.

C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

- - END - -

SECTION 31 20 11
EARTHWORK (SHORT FORM)

PART 1 - GENERAL

1.1:DESCRIPTION:

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

1.2 DEFINITIONS:

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proofrolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Resident Engineer's approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trenchwork throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in AASHTO T99 Method A.

D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements : Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

B. Classified Excavation: Removal and disposal of all material not defined as rock.

C. Rock Excavation:

1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).
2. Bedded or conglomerate deposits so cemented as to present characteristics of solid rock which cannot be excavated without blasting; or the use of a modern power excavator (shovel, backhoe, or similar power excavators) of no less than 0.75 m3 (1 cubic yard) capacity, properly used, having adequate power and in good running condition.
3. Boulders or other detached stones each having a volume of 0.4 m3 (1/2 cubic yard) or more.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:

Measurement: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. Quantities should be computed by a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. The measurement will not include the volume of subgrade material or other material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow its, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to taking of elevations and measurements of the undisturbed grade.

1.6 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION:

A. Measurement: Cross section and measure the uncovered and separated materials, and compute quantities by the Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:

1. 300 mm (12 inches) outside of the perimeter of formed footings.

2. 600 mm (24 inches) outside the face of concrete work for which forms are required, except for footings.
3. 150 mm (6 inches) below the bottom of pipe and not more than the pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
4. The outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).

B. Payment for Differing Site Conditions: When rock excavation, as classified, is encountered, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

1.7 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Rock Excavation Report:

1. Certification of rock quantities excavated.
2. Excavation method.
3. Labor.
4. Equipment.
5. Land Surveyor's or Civil Engineer's name and official registration stamp.
6. Plot plan showing elevations.

C. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

D. Furnish to Resident Engineer, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.

E. Qualifications of the commercial testing laboratory or Contractor’s Testing facility shall be submitted.

1.8 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Nursery and Landscape Association (ANLA):

2004 .....American Standard for Nursery Stock

C. American Association of State Highway and Transportation Officials (AASHTO):

T99-10 .....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-10 .....Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (18 inch) Drop

D. American Society for Testing and Materials (ASTM):

C33-03 .....Concrete Aggregate

D698-e1.....Laboratory Compaction Characteristics of Soil Using Standard Effort

D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-09.....Laboratory Compaction Characteristics of Soil Using Modified Effort

D2167-94 (2001) .....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2487-06.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)

D6938-10.....Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

E. Standard Specifications of Vermont State Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.

B. Granular Fill:

1. Under concrete slab, granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C33 with a maximum of 3 percent by weight passing ASTM D1140, 75 micrometers (No. 200) sieve.
2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.

D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.

E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod when available. Deliver sod to site immediately after cutting and in a moist condition. Thickness of cut must be 19 mm to 32 mm (3/4 inch to 1 1/4 inches) excluding top growth. There shall be no broken pads and torn or uneven ends

G. Buried Warning and Identification Tape: Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, “CAUTION, BURIED (intended service) LINE BELOW” or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

H. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.

I. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastictape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m(3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

J. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

A. Clearing: Clearing within the limits of earthwork operations as described or designated by the Resident Engineer. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Medical Center.

B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.

C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7’-6”) of utility lines if such removal is approved in advance by the Resident Engineer. Remove materials from the Medical Center . Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a

minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs that are to remain, than the farthest extension of their limbs.

D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the Resident Engineer. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m3 (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.

2. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and ensure final score lines are approximately parallel unless otherwise indicated. Remove material from the Medical Center.

E. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

A. Shoring, Sheeting and Bracing: Shore, brace, or slope to it's angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.

1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support in compliance with Specification Section 31 23 23.33, FLOWABLE FILL, under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.

B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the Resident Engineer should be contacted to consider the use of flowable fill. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, the water level shall be maintained continuously, at least 0.50 feet) below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of

observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.

C. Blasting: Blasting shall not be permitted.

D. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft material to solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
3. Do not tamp earth for backfilling in footing bottoms, except as specified.

E. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
   a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
   b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
   c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.
   d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the Resident Engineer.
   e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
   f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame,

and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
   1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
   2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.
   3) Clean, coarse-grained sand classified as in accordance with DOT State Standard.
   4) Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified in accordance with DOT State Standard. Maximum particle size shall not exceed 75 mm (3 inches).

2. Sanitary and storm sewer trenches:
   a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (l2 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
   b. The bottom quadrant of the pipe shall be bedded on suitable undisturbed soil or granular fill. Unstable material removed from the bottom of the trench or excavation

shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.

1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.

c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

d. Use granular fill for bedding where rock or rocky materials are excavated.

e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade

f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.
3) Clean, coarse-grained sand classified as in accordance with DOT State Standard.
4) Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified in accordance with DOT State Standard. Maximum particle size shall not exceed 75 mm (3 inches).

F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials that are determined by the Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on meters (yardage) in cut section only.

G. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas - 100 mm (4 inches) below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING:

A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing

applied, and pipes coming in contact with backfill have been installed, and inspected and approved by Resident Engineer.

B. Proof-rolling Existing Subgrade: - Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the building pad with six passes of a dump truck loaded with 6 cubic meters (4 cubic yards) of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Resident Engineer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Resident Engineer. Rutting or pumping of material shall be undercut as directed by the Resident Engineer and replaced with select material.

C. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.

D. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the Resident Engineer. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each layer to not less than 95 percent of the maximum density determined in accordance with the following test method AASHTO T99 Method A. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure.

E. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow

shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

F. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Resident Engineer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.4 GRADING:

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.

C. Slope backfill outside the building away from the building walls for a minimum distance of 3048 mm (10 feet)at a minimum five percent (5%) slope.

D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.

E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.

F. Finish subgrade in a condition acceptable to the Resident Engineer at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.

G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS:

A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by Resident Engineer before seeding or sodding operation begins.

B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 100 mm (4 inches) of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.

C. Fertilizing: Incorporate fertilizer into the soil to a depth of 100 mm (4 inches) at a rate of 12 kg/100 m2 (25 pounds per 1000 square feet).

D. Seeding: Seed at a rate of 2 kg/100 m2 (4 pounds per 1000 square feet) and accomplished only during periods when uniform distribution may be assured. Lightly rake seed into bed immediately after seeding. Roll seeded area immediately with a roller not to exceed 225 kg/m (150 pounds per foot) of roller width.

E. Sodding: Topsoil shall be firmed by rolling and during periods of high temperature the topsoil shall be watered lightly immediately prior to laying sod. Sod strips shall be tightly butted at the ends and staggered in a running bond fashion. Placement on slopes shall be from the bottom to top of slope with sod strips running across slope. Secure sodded slopes by pegging or other approved methods. Roll sodded area with a roller not to exceed 225 kg/m (150 pounds per foot) of the roller width to improve contact of sod with the soil.

F. Watering: The Resident Engineer is responsible for having adequate water available at the site. As sodding is completed in any one section, the entire sodded area shall be thoroughly irrigated by the contractor, to a sufficient depth, that the underside of the new sod pad and soil,

immediately below sod, is thoroughly wet. Resident Engineer will be responsible for sod after installation and acceptance.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.

B. Place excess excavated materials suitable for fill and/or backfill on site where directed.

C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

D. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN-UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the Medical Center.

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SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
   1. Implementation of the Erosion and Sedimentation Control Plan.
   2. Dewater excavations, including seepage and precipitation.

B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated and concrete placed, in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.

B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.

C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.

D. Maintain stability of sides and bottom of excavation.

E. Construction operations are performed in the dry.

F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:

1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water, or ensure excavations are dry before additional work is undertaken.

G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.

F. Excavation, backfilling, site grade and utilities: Section 31 20 11, EARTHWORK (SHORT FORM).

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Drawings and Design Data:

1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
3. Include a written report outlining control procedures to be adopted if dewatering problem arises.

4. Capacities of pumps, prime movers, and standby equipment.
5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.
6. Detailed description of dewatering procedure and maintenance method.
7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.

B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.

B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

A. Dispose of water removed from the excavations in such a manner as:

1. Will not endanger portions of work under construction or completed.
2. Will cause no inconvenience to Government or to others working near site.
3. Will comply with the stipulations of required permits for disposal of water.
4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.

B. Excavation Dewatering:
1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Ensure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subbase for concrete pavements.
2. Curbs, gutters, and combination curbs and gutters wheel stops.
3. Pedestrian Pavement: Walks, grade slabs, lawn mower strips, pedestrian crossings, wheelchair curb ramps, and steps.
4. Vehicular Pavement: Service courts, driveways, parking lots, and loading docks.
5. Equipment Pads: Oxygen storage, transformers, propane tanks, and generator pads.

1.2 RELATED REQUIREMENTS

A. Field Testing: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Step Nosings and Railings: Section 05 50 00, METAL FABRICATIONS.

C. Subgrade Preparation and Subbase Compaction: Section 31 20 11, EARTHWORK (SHORT FORM).

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. M147-65-UL-04 - Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
2. M233-86 - Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.

C. American Concrete Institute (ACI):

1. 305R-10 - Guide to Hot Weather Concreting.
2. 306R-10 - Guide to Cold Weather Concreting.

D. American National Standards Institute (ANSI):

1. B101.3 - Wet DOCF of Common Hard Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values).

E. ASTM International (ASTM):

1. A615/A615M-16 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
2. A996/A996M-15 - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

3. A1064/A1064M-16 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
4. C33/C33M-16 - Concrete Aggregates.
5. C94/C94M-16 - Ready Mixed Concrete.
6. C143/C143M-15a - Slump of Hydraulic Cement Concrete.
7. C150/C150M-16 - Portland Cement.
8. C171-16 - Sheet Materials for Curing Concrete.
9. C260/C260M-10a - Air Entraining Admixtures for Concrete.
10. C309-11 - Liquid Membrane Forming Compounds for Curing Concrete.
11. C494/C494M-15a - Chemical Admixtures for Concrete.
12. C618-15 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
13. C979/C979M-16 - Pigments for Integrally Colored Concrete.
14. C989/C989M-14 - Slag Cement for Use in Concrete and Mortars.
15. C1240-15 - Silica Fume Used in Cementitious Mixtures.
16. D1751-04(2013)e1 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
17. D5893/D5893M-10 - Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
18. D6690-15 - Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
   1. Required Participants:
      a. Contracting Officer's Representative.
      b. Architect/Engineer.
      c. Inspection and Testing Agency.
      d. Contractor.
      e. Installer.
      f. Other installers responsible for adjacent and intersecting work, including excavation, plantings, and traffic markings.
   2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
      a. Installation schedule.

b. Installation sequence.

c. Preparatory work.

d. Protection before, during, and after installation.

e. Installation.

f. Terminations.

g. Transitions and connections to other work.

h. Inspecting and testing.

i. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

2. Show reinforcing.

3. Include jointing plan for concrete pavements, curbs and gutters.

C. Manufacturer's Literature and Data:

1. Description of each product.

2. Installation instructions.

D. Samples:

1. Exposed Aggregate Concrete Panel: 0.4 sq. m by 50 mm (4 sq. ft. by 2 inches) thick, 2 required, each color and finish.

2. Colored Concrete Panel: As specified in Section 09 06 00, SCHEDULE FOR FINISHES, with mix data.

E. Test reports: Certify products comply with specifications.

1. Concrete materials.

2. Select subbase materials.

3. Field test reports.

F. Certificates: Certify products comply with specifications.

1. Expansion joint filler.

2. Reinforcement.

3. Curing materials.

4. Concrete protective coating.

G. Qualifications: Substantiate qualifications comply with specifications.

1. Installer with project experience list.
2. Land surveyor.

H. Concrete mix design.

I. Select subbase job-mix design.

J. Proposed hot and cold weather concreting methods.

K. Land surveyor's construction staking notes, before placing concrete.

1. Identify discrepancies between field conditions and Drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations.
   a. Project Experience List: Provide contact names and addresses for completed projects.

B. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.

C. Preconstruction Testing:

1. Engage independent testing laboratory to perform tests and submit reports.
   a. Deliver samples to laboratory in number and quantity required for testing.
2. Concrete mix design.
3. Select subbase job-mix design. Report the following:
   a. Material sources.
   b. Gradation.
   c. Plasticity index.
   d. Liquid limit.
   e. Laboratory compaction curves indicating maximum density at optimum moisture content.

1.7 DELIVERY

A. Deliver steel reinforcement to prevent damage.

B. Before installation, return or dispose of distorted or damaged steel reinforcement.

C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.8 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

A. Hot Weather Concreting Procedures: ACI 305R.

B. Cold Weather Concreting Procedures: ACI 306R.

1. Use non-corrosive, non-chloride accelerator admixture.
2. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

1.10 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II.

B. Pozzolans:

1. Fly Ash: ASTM C618, Class C or F including supplementary optional physical requirements.
2. Slag: ASTM C989/C989M; Grade 80, Grade 100 or Grade 120.
3. Silica Fume: ASTM C1240.

C. Coarse Aggregate: ASTM C33/C33M; size to suit application.

D. Fine Aggregate: ASTM C33/C33M.

E. Mixing Water: Fresh, clean, and potable.

F. Air-Entraining Admixture: ASTM C260/C260M.

G. Chemical Admixtures: ASTM C494/C494M.

H. Reinforcing Steel: ASTM A615/A615M or ASTM A996/A996M, Grade 280 (40deformed.

I. Welded Wire Fabric: ASTM A1064/A1064M, plain; Grade 385 (56 sized as indicated.

J. Expansion Joint Filler: ASTM D1751.

K. Sheet Materials for Curing Concrete: ASTM C171.

L. Color Pigment: ASTM C979/C979M, colored and white powder pigments.

2.2 SELECT SUBBASE

A. Subbase: AASHTO M147; Grade A.

1. Select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials.

SUBBASE GRADING REQUIREMENTS							
Sieve Size		Percentage Passing by Mass					
		Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

B. Other Acceptable Gradations: Materials within three to five percent, plus or minus, of specified gradation, or as recommended by the geotechnical engineer and approved by the Contracting Officer's Representative.

2.3 FORMS

A. Forms: Wood, plywood, metal, or other materials, approved by Contracting Officer's Representative, of grade or type suitable to obtain type of finish specified.

1. Plywood: Exterior grade, free of defects and patches on contact surface.
2. Lumber: Sound, grade-marked, S4S stress graded softwood, minimum 50 mm (2 inches) thick, free from warp, twist, loose knots, splits, or other defects.
3. Form Coating: As recommended by Architect/Engineer.

B. Provide forms suitable in cross-section, depth, and strength to resist springing during depositing and consolidating concrete.

1. Do not use forms varying from straight line more than 3 mm in 3000 mm (1/8 inch in 10 feet), horizontally and vertically.

C. Provide flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

A. Concrete curing materials, conform to one of the following:

1. Burlap: Minimum 233 g/sq. m (7 ounces/sq. yd.) dry.
2. Sheet Materials for Curing Concrete: ASTM C171.
3. Curing Compound: ASTM C309, Type 1 clear; liquid membrane forming type, without paraffin or petroleum.

2.5 CONCRETE MIXES

A. Design concrete mixes according to ASTM C94/C94M, Option C.

B. Concrete Type: Non-air-entrained. See Table I.

TABLE I - CONCRETE TYPES					
Concrete Type	Minimum 28 Day Compressive Strength f'c MPa (psi)	Non-Air-Entrained		Air-Entrained	
		Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio
A	35 (5000)1,3	375 (630)	0.45	385 (650)	0.40
B	30 (4000)1,3	325 (550)	0.55	340 (570)	0.50
C	25 (3000)1,3	280 (470)	0.65	290 (490)	0.55
D	25 (3000)1,2	300 (500)	*	310 (520)	*

Footnotes:

1. If trial mixes are used, achieve compressive strength 8.3 MPa (1,200 psi) in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi), achieve compressive strength 9.7 MPa (1,400 psi) in excess of f’c.
2. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement ratio is 0.44.
3. Laboratory Determined according to ACI 211.1 for normal weight concrete.

C. Maximum Slump: ASTM C143/C143M. See Table II.

TABLE II - MAXIMUM SLUMP	
APPLICATION	MAXIMUM SLUMP
Curb & Gutter	75 mm (3 inches)

TABLE II - MAXIMUM SLUMP	
APPLICATION	MAXIMUM SLUMP
Pedestrian Pavement	75 mm (3 inches)
Vehicular Pavement	50 mm (2 inches) Machine Finished 100 mm (4 inches) Hand Finished
Equipment Pad	75 to 100 mm (3 to 4 inches)

2.6 ACCESSORIES

A. Equipment and Tools: Obtain Contracting Officer's Representative's, approval of equipment and tools needed for handling materials and performing work before work begins.

B. Maintain equipment and tools in satisfactory working condition.

C. Sealants:

1. Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.

D. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Prepare, construct, and finish subgrade. See Section 31 20 00, EARTHWORK.

D. Maintain subgrade in smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE

A. Placing:

1. Place subbase material on prepared subgrade in uniform layer to required contour and grades, and to maximum 200 mm (8 inches) loose depth.
2. When required compacted thickness exceeds 150 mm (6 inches), place subbase material in equal thickness layers.
3. When subbase elevation is 13 mm (1/2 inch) or more below required grade, excavate subbase minimum 75 mm (3 inches) deep. Place and compact subbase to required grade.

B. Compaction:

1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
2. Maintain subbase at optimum moisture content for compaction.
3. Compact each subbase layer to minimum 95 percent or 100 percent of maximum density as specified in Section 31 20 11, EARTHWORK (SHORT FORM).

C. Subbase Tolerances:

1. Variation from Indicated Grade: Maximum 9 mm (3/8 inch).
2. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).

D. Protection:

1. Protect subbase from damage until concrete is placed.
2. Reconstruct damaged subbase before placing concrete.

3.3 SETTING FORMS

A. Form Substrate:

1. Compact form substrate to uniformly support forms along entire length.
2. Correct substrate imperfections and variations by cutting, filling, and compacting.

B. Form Setting:

1. Set forms to indicated line and grade with tight joints. Rigidly brace forms preventing movement.
2. Remove forms when removal will not damage concrete and when required for finishing.
3. Clean and oil forms before each use.
4. Correct forms, when required, immediately before placing concrete.

C. Land Surveyor: Establish control, alignment, and grade for forms.

1. Notify Contracting Officer's Representative immediately when discrepancies exist between field conditions and drawings.
2. Correct discrepancies greater than 25 mm (1 inch) before placing concrete.

D. Form Tolerances:

1. Variation from Indicated Line: Maximum 6 mm (1/4 inch).
2. Variation from Indicated Grade: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).

3.4 PLACING REINFORCEMENT

A. Keep reinforcement clean from contamination preventing concrete bond.

B. Install reinforcement shown on drawings.

C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.

D. Obtain Contracting Officer's Representative's reinforcement placement approval before placing concrete.

3.5 JOINTS - GENERAL

A. Place joints, where shown on approved submittal Drawings.

1. Conform to details shown.
2. Install joints perpendicular to finished concrete surface.

B. Make joints straight and continuous from edge to edge of pavement.

3.6 CONSTRUCTION JOINTS

A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown on approved submittal Drawings.

B. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.

C. Provide butt-type joint with dowels in curb and gutter at planned joint locations.

D. Provide keyed joints with tie bars when joint occurs in middle third of planned curb and gutter joint interval.

3.7 CONTRACTION JOINTS

A. Tool or cut joints to width, depth, and radius edge shown on drawings using grooving tool, jointer, or saw.

B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections.

1. Keep plates in place until concrete can hold its shape.

C. Finish joint edges with edging tool.

D. Score pedestrian pavement with grooving tool or jointer.

3.8 EXPANSION JOINTS

A. Form expansion joints with expansion joint filler of thickness shown on drawings.

1. Locate joints around perimeter of structures and features abutting site work concrete.
2. Create complete, uniform separation between structure and site work concrete.

B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on Drawings.

C. Cut and shape material matching cross section.

D. Anchor with approved devices to prevent displacing during placing and finishing operations.

E. Round joint edges with edging tool.

3.9 PLACING CONCRETE - GENERAL

A. Preparation before Placing Concrete:

1. Obtain Contracting Officer's Representative approval.
2. Remove debris and other foreign material.
3. Uniformly moisten substrate, without standing water.

B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.

C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.

1. Vibrate concrete against forms and along joints.
2. Avoid excess vibration and handling causing segregation.

D. Place concrete continuously between joints without bulkheads.

E. Install construction joint in concrete placement suspended for more than 30 minutes.

F. Replace concrete with cracks, chips, bird baths, and other defects to nearest joints, approved by Contracting Officer's Representative.

3.10 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

A. Place concrete in one layer conforming to cross section shown on Drawings after consolidating and finishing.

B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.

C. Strike concrete surface to proper section ready for consolidation.

D. Consolidate concrete by tamping and spading or with approved mechanical finishing equipment.

E. Finish concrete surface with wood or metal float.

F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.11 PLACING CONCRETE FOR VEHICULAR PAVEMENT

A. Deposit concrete as close as possible to its final position.

B. Place concrete continuously between construction joints without cold joints.

C. Strike and consolidate concrete with finishing machine, vibrating screed, or by hand-finishing.

D. Finish concrete surface to elevation and crown shown on drawings.

E. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.

F. Obtain Contracting Officer's Representative's approval before placing adjacent lanes.

G. Curb-Forming Machines: Curb-forming machines for constructing curbs and gutter will be approved based on trial use on the project. When equipment produces unsatisfactory results, discontinue use of the equipment at any time during construction and accomplish work by hand method construction. Remove unsatisfactory work and reconstruct full length between regularly scheduled joints. Dispose of removed portions off the project site.

3.12 FORM REMOVAL

A. Keep forms in place minimum 12 hours after concrete placement. Remove forms without damaging concrete.

B. Do not use bars or heavy tools against concrete to remove forms. Repair damage concrete found after form removal.

3.13 CONCRETE FINISHING - GENERAL

A. Follow operation sequence below, unless otherwise indicated on Drawings:

1. Consolidating, floating, striking, troweling, texturing, and joint edging.

B. Use edging tool with 6 mm (1/4 inch) radius, unless otherwise shown on Drawings.

C. Keep finishing equipment and tools clean and suitable for use.

3.14 CONCRETE FINISHING - PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs, Lawn Mower Crossings, Wheelchair Curb Ramps, Terraces, Healing Gardens:

1. Finish concrete surfaces with metal float, troweled smooth, and finished with a broom moistened with clear water.

2. Finish slab edges and formed transverse joints with edger.

3. Broom surfaces transverse to traffic direction.

a. Use brooming to eliminate flat surface produced by edger.

b. Produce uniform corrugations, maximum 1.5 mm (1/16 inch) deep profile.

4. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.

5. Paving Tolerances:

a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).

b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).

6. Replace paving within joint boundary when paving exceeds specified tolerances.

B. Step Treads, Risers and Sidewalls: Finish as specified for pedestrian pavement, except as follows:

1. Remove riser forms sequentially, starting with top riser.

2. Rub riser face with wood or concrete rubbing block and water. Remove blemishes, form marks, and tool marks. Use outside edger to round nosing; use inside edger to finish bottom of riser.

3. Apply uniform brush finish to treads, risers, and sidewall.

a. Apply stiff brush finish to treads to provide slip resistant surface complying with ANSI B101.3.

4. Step Tolerance:

a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).

3.15 CONCRETE FINISHING - VEHICULAR PAVEMENT

A. Align finish surfaces where new and existing pavements abut.

B. Longitudinally float pavement surface to profile and grade indicated on drawings.

C. Straighten surface removing irregularities and maintaining specified tolerances while concrete is plastic.

D. Finish pavement edges and joints with edging tool.

E. Broom finish concrete surface after bleed water dissipates and before concrete hardens.

1. Broom surface transverse to traffic direction.

a. Use brooming to eliminate flat surface produced by edger.

b. Produce uniform corrugations, maximum 3 mm (1/8 inch) deep profile.

F. Pavement Tolerances:

1. Variation from Indicated Plane: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet) tested parallel and perpendicular to traffic direction at maximum 1500 mm (5 feet) intervals.

2. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).

G. Replace paving within joint boundary when paving exceeds specified tolerances.

3.16 CONCRETE FINISHING - CURBS AND GUTTERS

A. Round edges of gutter and top of curb with edging tool.

B. Gutter and Curb Top:

1. Float surfaces and finish with smooth wood or metal float until true to grade and section and uniform color.
2. Finish surfaces, while still plastic, longitudinally with bristle brush.

C. Curb Face:

1. Remove curb form and immediately rub curb face with wood or concrete rubbing block removing blemishes, form marks, and tool marks and providing uniform color.
2. Brush curb face, while still plastic, matching gutter and curb top.

D. Curb and Gutter Tolerances: Except at grade changes or curves.

1. Variation from Indicated Plane and Grade:
   a. Gutter: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
   b. Curb Top and Face: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet).

E. Replace curbs and gutters within joint boundary when curbs and gutters exceed specified tolerances.

F. Correct depressions causing standing water.

3.17 CONCRETE FINISHING - EQUIPMENT PADS

A. Strike pad surface to elevation shown on Drawings.

B. Provide smooth, dense float finish, free from depressions or irregularities.

C. Finish pad edges with edger.

D. After removing forms, rub pad edge faces with wood or concrete rubbing block, removing blemishes, form marks, and tool marks and providing uniform color.

E. Pad Tolerances:

1. Variation from Indicated Plane: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
2. Variation from Indicated Elevation: Maximum 6 mm (1/4 inch).
3. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).

F. Replace pads when pads exceed specified tolerances.

3.18 SPECIAL FINISHES

A. Exposed Aggregate Finish:

1. Prepare concrete base 10 to 13 mm (3/8 to 1/2 inch) lower than the finish grade.
2. Scatter aggregate over concrete base surface and embed by use of hand float, straight edge, or darby.

3. Apply concrete mix and mark off surface as indicated on Drawings with surface joints at least 10 mm (3/8 inch) deep. Level off finish to a true surface and compact with wood float, working as little as possible so that coarse material will remain at the top. Before finish has set, treat top surface with cement retarding material. When body of concrete finish has set, remove retarded surface film by wire brushes and fine water spray to remove mortar from top of colored aggregate. Continue washing and brushing until flush water runs clear and no noticeable cement film left on the aggregate.

3.19 CONCRETE CURING

A. Concrete Protection:
   1. Protect unhardened concrete from rain and flowing water.
   2. Provide sufficient curing and protection materials available and ready for use before concrete placement begins.
   3. Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
      a. Replace pavement damaged by curing method allowing concrete cracking.
      b. Employ another curing method as directed by Contracting Officer's Representative.

B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:
   1. Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap Mats at least 150 mm (6 inches).
   2. Sheet Materials:
      a. Wet exposed concrete surface with fine water spray and cover with sheet materials.
      b. Overlap sheets minimum 300 mm (12 inches).
      c. Securely anchor sheet materials preventing displacement.
   3. Curing Compound:
      a. Protect joints indicated to receive sealants preventing contamination from curing compound.
      b. Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
      c. Apply curing compound before concrete dries.
      d. Apply curing compound in two coats at right angles to each other.
      e. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gallon), both coats.
      f. Immediately reapply curing compound to surfaces damaged during curing period.

3.20 CONCRETE PROTECTIVE COATING

A. Apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against concrete exterior improvements to protect the concrete against deicing materials.

B. Complete backfilling and curing operation before applying protective coating.

C. Dry and thoroughly clean concrete before each application.

D. Apply two coats, with maximum coverage of 11 sq. m/L (50 sq. yds./gal.); first coat, and maximum 16 sq. m/L (70 sq. yds./gal.); second coat, except apply commercially prepared mixture according to manufacturer's instructions.

E. Protect coated surfaces from vehicular and pedestrian traffic until dry.

F. Do not heat protective coating, and do not expose protective coating to open flame, sparks, or fire adjacent to open containers or applicators. Do not apply material at temperatures lower than 10 degrees C (50 degrees F).

3.21 FIELD QUALITY CONTROL

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

1. Compaction.
   a. Pavement subgrade.
   b. Curb, gutter, and sidewalk.
2. Concrete:
   a. Delivery samples.
   b. Field samples.
3. Slip Resistance: Steps and pedestrian paving.

3.22 CLEANING

A. After completing curing:

1. Remove burlap and sheet curing materials.
2. Sweep concrete clean, removing foreign matter from the joints.
3. Seal joints as specified.

3.23 PROTECTION

A. Protect exterior improvements from traffic and construction operations.

1. Prohibit traffic on paving for minimum seven days after placement, or longer as directed by Contracting Officer's Representative.

B. Remove protective materials immediately before acceptance.

C. Repair damage.

1. Replace concrete containing excessive cracking, fractures, spalling, and other defects within joint boundary, when directed by Contracting Officer's Representative, and at no additional cost to the Government.

- - - E N D - - -

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 11, EARTHWORK (SHORT FORM).

C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Data and Test Reports:

1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
3. Job-mix formula.

C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to State Highway Department requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.

D. One copy of State Highway Department Specifications.

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

A. Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Resident Engineer or VA Contracting Officer.

2.2 AGGREGATES

A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.

B. Subbase aggregate (where required) maximum size: 38mm (1-1/2").

C. Base aggregate maximum size:
   1. Base course over 152mm (6") thick: 38mm (1-1/2");
   2. Other base courses: 19mm (3/4").

D. Asphaltic base course:
   1. Maximum particle size not to exceed 25.4mm (1”).
   2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm (3/4")	100

9.5mm (3/8")	67 to 85
6.4mm (1/4")	50 to 65
2.4mm (No. 8 mesh)	37 to 50
600µm (No. 30 mesh)	15 to 25
75µm (No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:
   1. Asphalt cement: Penetration grade 50/60
   2. Prime coat: Cut-back type, grade MC-250
   3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.
   1. Temperature leaving the plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
   2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.

B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.

C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.

D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.

E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

A. Subbase (when required)

1. Spread and compact to the thickness shown on the drawings.
2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.

B. Base

1. Spread and compact to the thickness shown on the drawings.
2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.

C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").

D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer’s recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:
1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:
1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
   a. No depressions which will retain standing water.
   b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

B. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

C. When sealing new asphalt paving wait an entire year to allow for the expansion and contraction of a year's cycle of both warm and cool temperatures. This allows for the asphalt's oils to properly cure and begin oxidation before applying a seal coat.

D. When seal coating in less than a year apply two coats, spray applied. This application method is preferred for less than a year application when there is still plenty of asphalt cement present for the seal coat to bond to.

E. When seal coating existing paving that has new asphalt patches, apply two coats sprayed to the existing asphalt and a single lighter coat on new patch work, just enough to make the color of the new patches match the rest of the reseal coated paving.

F. When resealing existing paving 5, 10, 15 years and older, that is oxidized and is very light in color, squeegee apply the first coat of seal coat and spray on a second coat. Two coats are preferred in older paving when the asphalt cement has oxidized leaving the seal coat with nothing to bond to other than the aggregate that in many cases has polished over time leaving less than a desirable surface to bond to.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Paint and reflective glass beads on pavement surfaces, in form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings.

1.2 RELATED REQUIREMENTS

A. Paint VOC Limits: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Paint Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. Federal Specifications (Fed. Spec.):

1. TT-B-1325D - Beads (Glass Spheres) Retro-Reflective.
2. TT-P-1952F - Paint, Traffic and Airfield Marking, Waterborne.

C. Master Painters Institute (MPI):

1. No. 97 - Traffic Marking Paint, Latex.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show pavement marking configuration and dimensions.
2. Show international symbol of accessibility at designated parking spaces.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Application instructions.

D. Samples:

1. Paint: 200 mm (8 inches) square, each type and color.

E. Certificates: Certify products comply with specifications.

F. Qualifications: Substantiate qualifications comply with specifications.

1. Installer with project experience list.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.
    a. Project Experience List: Provide contact names and addresses for completed projects.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.

B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:

1. Product Temperature: Minimum 13 degrees C (55 degrees F) for minimum 48 hours before installation.
    a. Surface to be painted and ambient temperature: Minimum 10 degrees C (50 degrees F) and maximum 35 degrees C (95 degrees F).

B. Field Measurements: Verify field conditions affecting traffic marking installation. Show field measurements on Submittal Drawings.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design paint complying with specified performance:

1. Application: Fed. Spec. TT-P-1952.

2.2 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide each product from one manufacturer and from one production run.

1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:

a. Paints and coatings.

2.3 SANDBLASTING EQUIPMENT

A. Air compressor, hoses, and nozzles of proper size and capacity as required for cleaning painted surfaces. Compressor to provide minimum 0.08 cu. m/s (150 cfm) of air at pressure of minimum 625 kPa (90 psi) at each nozzle used.

2.4 PAINT APPLICATOR

A. Apply marking paint with approved mechanical equipment. Provide equipment with constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in case of skip lines. Equipment to have manual control to apply continuous lines of varying length and marking widths as indicated on Drawings. Provide pneumatic spray guns for hand application of paint in areas where mobile paint applicator cannot be used. Use separate piece of equipment when equipment does not have glass bead dispenser. Adjust and synchronize equipment with paint applicator to distribute reflective beads on paint lines uniformly within ten seconds without any waste.

2.5 PAINT

A. Paint: MPI No. 97. For obliterating existing markings comply with Fed. Spec. TT-P-1952. Provide minimum 18 L (5 gallons) containers.

2.6 REFLECTIVE GLASS BEADS

A. Beads: Comply with Fed. Spec. TT-B-1325, Type I, Gradation A. In regions of high humidity, coat beads with silicone or other suitable waterproofing material to ensure free flow. Provide glass beads in containers suitable for handling and strong enough to prevent loss during shipment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Allow new pavement surfaces to cure for period of minimum 14 days before application of marking materials.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or combination of these methods.
2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by Contracting Officer's Representative.
3. As an option, comply with Fed. Spec. TT-P-1952 for removal of existing paint markings on asphalt pavement. Apply black paint in as many coats as necessary to completely obliterate existing markings.
4. Scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application, where oil or grease are present on old pavements to be marked.
   a. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through new paint.
5. Clean and dry surface before pavement marking. Do not begin any marking until Contracting Officer's Representative inspected surface and gives permission to proceed.

3.2 TEMPORARY PAVEMENT MARKING

A. Apply Temporary Pavement Markings of colors, widths and lengths shown on drawings or directed by Contracting Officer's Representative. After temporary marking has served its purpose and when so ordered by Contracting Officer's Representative, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method to prevent damage on applied surface.

B. As an option, provide approved preformed pressure sensitive, reflective, adhesive tape type of temporary pavement marking of required colors, widths and lengths in lieu of temporary painted and reflective marking. Continuous durability and effectiveness of such marking is required during period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted and reflective markings.

3.3 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.4 PAINT APPLICATION

A. Apply uniformly painted and reflective pavement marking of required colors, length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces.

B. Comply with details as indicated on drawings and established control points.

C. Apply paint at wet film thickness of 0.4 mm (0.015 inch). Disperse reflective glass beads evenly on wet paint at rate of 720 g/L (6 pounds per gal.) of paint. Apply paint in one coat. When directed by Contracting Officer's Representative, apply additional coats at markings showing light spots. Comply with paint manufacturer's maximum drying time requirements to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic.

D. When deficiency in marking drying occurs, discontinue paint operations until cause of slow drying is determined and corrected.

E. Remove and replace marking applied less than minimum material rates, deviates from true alignment, exceeds stipulated length and width tolerances, or shows light spots, faulty distribution of beads, smears, or other deficiencies or irregularities.

F. Remove marking by carefully controlled sandblasting, approved grinding equipment, or other approve method to prevent damage on applied surface.

3.5 DETAIL PAVEMENT MARKING APPLICATION

A. Apply Detail Pavement Markings, exclusive of actual traffic lane marking as follows:

1. At exit and entrance islands and turnouts.
2. On curbs.
3. At crosswalks.
4. At parking bays.
5. Other locations as indicated on drawings.

B. Apply International Handicapped Symbol at indicated parking spaces. Color as shown on drawings. Apply paint for symbol using suitable template that will provide pavement marking with true, sharp edges and ends.

C. Install detail pavement markings of colors, widths and lengths, and design pattern at locations indicated on drawings.

3.6 TOLERANCES

A. Length and Width of Lines: Plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in case of skip markings.

B. Length of intervals exceeding line length tolerance are not acceptable.

3.7 CLEANING

A. Remove excess paint before paint sets.

3.8 PROTECTION

A. Protect pavement markings from traffic and construction operations.

1. Protect newly painted markings from vehicular traffic until paint is dry and track free.
2. Place warning signs at beginning of wet line, and at points well in advance of marking equipment for alerting approaching traffic from both directions.
3. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.

B. Repair damage.

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SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances and all other incidentals.

1.2 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTHWORK (SHORT FORM).

B. General plumbing: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

D. Metering: Section 25 10 10, ADVANCED UTILITY METERING SYSTEM.

E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DEFINITIONS

A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.

B. Water service line: Pipeline from main line to 5 feet outside of building.

1.4 ABBREVIATIONS

A. PVC: Polyvinyl chloride plastic.

B. DI: Ductile iron pipe.

C. WOG: Water, Oil and Gas.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.

B. Use a sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

D. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

E. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.

F. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

1.6 COORDINATION

A. Coordinate connection to water main with Public Utility company.

B. Coordinate water service lines with building contractor.

1.7 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years. Digital electronic devices, software and systems such as controls, instruments or computer workstations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.

C. Regulatory requirements:

1. Comply with the rules and regulations of the public utility company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems.
2. Comply with the rules and regulations of the Federal, State and/or Local Health Department having jurisdiction for potable water-service.
3. Comply with rules and regulations of Federal, State, and/or Local authorities having jurisdiction for fire-suppression water-service piping including materials, hose threads, installation and testing.

D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp or other markings of the specified testing agency.

E. Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the American Welding Society.

F. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation.

G. Applicable codes:

1. Plumbing Systems: IPC, International Plumbing Code.
2. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
3. Fire-service main products shall be listed in the FM Global “Approval Guide” or Underwriters Laboratories (UL) “Fire Protection Equipment Directory”.

1.8 APPLICABLE PUBLICATIONS

Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):

MSS SP-60-2004 .....Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

MSS SP-108-2002.....Resilient-Seated Cast Iron, Eccentric Plug Valves

MSS SP-123-1998(R2006) ..... Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube

C. American Society of Mechanical Engineers (ASME):

A112.1.2-2004..... Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors))

A112.6.3-2001..... Floor Drains

B16.1-2010..... Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250

B16.18-2001..... Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2001..... Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

B16.24-2006..... Cast Copper Alloy Pipe Flanges and Flanged Fittings; Classes 150, 300, 600, 900, 1500 and 2500

B31 ..... Code for Pressure Piping Standards

D. American Society for Testing and Materials (ASTM):

A36/A36M-08 ..... Carbon Structural Steel

A48/A48M-08(2008)..... Gray Iron Castings

A536-84(2009) ..... Ductile Iron Castings

A674-10..... Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids

B61-08..... Steam or Valve Bronze Castings

B62-09..... Composition Bronze or Ounce Metal Castings

B88/B88M-09..... Seamless Copper Water Tube

C651-05..... Disinfecting Water Mains

C858-10e1..... Underground Precast Utility Structures

D1785-06..... Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2239-03.....Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D2464-06.....Threaded Poly (Vinyl Chloride) PVC Pipe Fittings, Schedule 80

D2466-06.....Poly (Vinyl Chloride) (PVC) Pipe Fittings, Schedule 40

D2467-06.....Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D2609-02(2008) .....Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe

D3350-10a.....Polyethylene Plastics Pipe and Fittings Materials

F714-10 .....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F1267-07 .....Metal, Expanded, Steel

E. American Water Works Association (AWWA):

B300-10.....Hypochlorites

B301-10.....Liquid Chlorine

C104-08.....Cement–Mortar Lining for Ductile Iron Pipe and Fittings

C105/A21.5-10 .....Polyethylene Encasement for Ductile Iron Pipe Systems

C110-08.....Ductile Iron and Gray-Iron Fittings

C111/A21.11-07 .....Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

C115/A21.11-11 .....Flanged Ductile Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges

C151/A21.51-09 .....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-11 .....Ductile Iron Compact Fittings for Water Service

C502-05.....Dry-Barrel Fire Hydrants

C503-05.....Wet-Barrel Fire Hydrants

C504-10.....Rubber-Seated Butterfly Valves

C508-09.....Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS

C509-09 ..... Resilient-Seated Gate Valves for Water Supply Service

C510-07 ..... Double Check Valve Backflow Prevention Assembly

C511-07 ..... Reduced-Pressure Principle Backflow Prevention Assembly

C512-07 ..... Air Release, Air/Vacuum and Combination Air Valves

C550-05 ..... Protective Interior Coatings for Valves and Hydrants

C600-10 ..... Installation of Ductile Iron Mains and Their Appurtenances

C605-11 ..... Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

C606-11 ..... Grooved and Shouldered Joints

C651-05 ..... Disinfecting Water Mains

C700-09 ..... Cold-Water Meters, “Displacement Type,” Bronze Main Case

C800-05 ..... Underground Service Line Valves and Fittings

C900-09 ..... Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

C906-07 ..... Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 64 In. (1,600 mm), for Water Distribution and Transmission

C907-04 ..... Injection-Molded PVC Pressure Fittings, 4 Inch through 12 Inch (100 mm through 300 mm), for Water Distribution

M23-2nd Ed..... PVC Pipe, Design and Installation

M44-2nd Ed..... Distribution Valves: Selection, Installation, Field Testing and Maintenance

F. National Fire Protection Association (NFPA):

NFPA 24-2010 Ed. ..... Installation of Private Fire Service Mains and Their Appurtenances

NFPA 1963-2009 Ed. ..... Fire Hose Connections

G. NSF International (NSF):

NSF/ANSI 14 (2013).....Plastics Piping System Components and Related Materials

NSF/ANSI 61-2012.....Drinking Water System Components - Health Effects

NSF/ANSI 372-2011.....Drinking Water System Components – Lead Content

H. American Welding Society (AWS):

A5.8/A5.8M-2004 .....Filler Metals for Brazing and Braze Welding

I. American Society of Safety Engineers (ASSE):

1003-2009 .....Water Pressure Reducing Valves

1015-2009.....Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

1020-2004.....Pressure Vacuum Breaker Assembly

1047-2009.....Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies

1048-2009.....Performance Requirements for Double Check Detector Fire Protection Backflow Prevention Assemblies

1060-2006.....Performance Requirements for Outdoor Enclosures for Fluid Conveying Components

J. Underwriters' Laboratories (UL):

246 .....Hydrants for Fire-Protection Service

262 .....Gate Valves for Fire-Protection Service

312 .....Check Valves for Fire-Protection Service

405 .....Fire Department Connection Devices

753 .....Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service

789 .....Indicator Posts for Fire-Protection Service

1091 .....Butterfly Valves for Fire-Protection Service

1285 .....Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service

1.9 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF/ANSI 61 or NSF 372.

B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.3 SAFETY GUARDS

A. All equipment shall have moving parts protected to prevent personal injury. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gauge sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch (6 mm) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.4 LIFTING ATTACHMENTS

A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 DUCTILE IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, round-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances: ASTM A47, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe, 350 psi (3400 kPa).
2. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions, Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
3. Gaskets: AWWA C111.

D. Flanged Ductile Iron Pipe: AWWA C115/A21.11, with factory applied screwed long hub flanges.

1. Flanges: ASME B16.1 for 125 psi (850 kPa) pressure ratings, as necessary.
2. Wall Sleeve Castings, size and types shown on the drawings, shall be hot dipped galvanized per ASTM A123.
3. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall be shop primed with one coat of rust inhibitive primer. Final paint color shall match the final wall color.

E. Cement Mortar Internal Lining: Cement mortar lining and bituminous seal coat as per AWWA C104.

F. Exterior Pipe Coating: The exterior of pipe shall have the standard asphaltic coating.

2.6 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D2466.

B. PVC, Schedule 80 Pipe: ASTM D1785.

1. PVC, Schedule 80 Socket Fittings: ASTM D2467.
2. PVC, Schedule 80 Threaded Fittings: ASTM D2464.

C. PVC, AWWA Pipe: AWWA C900, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.
   a. Gaskets: AWWA C111, rubber.
5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.7 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psi (1100 kPa) .

1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 160 psi (1100 kPa).

1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 160 psi (1100 kPa).

C. PE, Fire-Service Pipe: ASTM F714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150.

1. Molded PE Fittings: ASTM D3350, PE resin, socket-or butt-fusion type, made to match PE pipe dimensions and class.

2.8 COPPER TUBE AND FITTINGS

A. Soft Copper Tubing: ASTM B88, Type K water tube, annealed temper.

B. Hard Copper Tubing: ASTM B88, Type K water tube, drawn temper.

C. Fittings: ASME B16.18, cast copper alloy solder joint pressure fittings.

D. Brazing Alloy: AWS A5.8/A5.8M, Classification BCuP.

E. Bronze Flanges: ASME B16.24, Class 150, with solder joint ends.

F. Copper Unions: ANSI MSS SP-123, cast copper alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.9 VALVES

A. Gate Valves: AWWA C509, Non-rising Stem, Resilient Seat, 200 psi (1380 kPa).

1. Valves 3 inches (75 mm) and larger: Resilient seat valve with gray- or ductile iron body and bonnet; cast iron or bronze double-disc gate; bronze gate rings; non-rising bronze stem and stem nut.
2. Interior and exterior coating: AWWA C550, thermo-setting or fusion epoxy.
3. Underground valve nut: Furnish valves with 2-inch (50 mm) nut for socket wrench operation.
4. Aboveground and pit operation: Furnish valves with hand wheels.
5. End connections shall match main line pipe.

B. Gate Valve Accessories and Specialties

1. Tapping-Sleeve Assembly: ANSI MSS SP-60; sleeve and valve to be compatible with the drilling matching.
   a. Tapping Sleeve: Cast or Ductile Iron or Stainless-Steel, two-piece bolted sleeve. Sleeve to match the size and type of pipe material being tapped.
   b. Valve shall include one raised face flange mating tapping-sleeve flange.
2. Valve Boxes: AWWA M44 with top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.
3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut. (Provide two wrenches for Project.)
4. Indicator Posts: UL 789, FMG approved, vertical-type, cast iron body with operating wrench, extension rod, and adjustable cast iron barrel of length required for depth of burial of valve.

C. Corporation Valves and Curb Valves

1. Service-Saddle Assemblies: AWWA C800.
   a. Service Saddle: Copper alloy with seal and threaded outlet for corporation valve.

b. Corporation Valve: Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.

c. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

D. Post-Indicator: NFPA 24 and be fully compatible with the valve and supervisory switches.

E. Water Control Valves

1. Valve to be pilot operation, diaphragm-type, single-seated, pressure rating should be 150 psi (1035 kPa) minimum. Include small pilot control valve, restrictor device, specialty fittings and sensor piping.

   a. Size: Insert NPS (DN)

   b. Pattern: Angle Glove -valve design

   c. Trim: Stainless steel

   d. Design flow rate: Insert gpm (L/s)

   e. Design inlet pressure: Insert psi (kPa)

   f. Design outlet pressure setting: Insert psi (kPa)

2. Body shall be cast or ductile iron with AWWA C550 epoxy coating or stainless steel.

3. End connections: Threaded for NPS 2 (DN 50) and smaller.

4. End connections: Flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

5. Interior coating: AWWA C550.

2.10 FIRE HYDRANTS

A. All hydrants shall have removable interiors capable of replacement without digging up the hydrant and be packable under pressure. Threaded joints or spindles shall be bronze and upper and lower barrels shall be of equal diameter. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 4 inches (100 mm) above finished grade. All fire hydrants shall have 6-inch (150 mm) bottom connection. Provide 2 hydrant wrenches not less than 14 inches (350 mm) long. Pressure Rating: 150 psi (1035 kPa) minimum. Hydrant valve shall open by turning operating nut to left or counterclockwise. Exterior finish shall be red alkyd-gloss enamel paint, unless otherwise indicated. Outlet threads shall meet NFPA 1963, with external hose thread used by local fire department. Include cast iron caps with steel chains and Pentagon, 1-1/2 inch (38 mm) point to flat operating and cap nuts.

B. Dry-Barrel Fire Hydrants:

1. AWWA C502, freestanding, one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4 inch (133 mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet; interior coating according to AWWA C550; cast iron body, compression-type valve opening against pressure and closing.
2. UL 246, freestanding, one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4 inch (133 mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet; cast iron body, compression-type valve opening against pressure and closing.

C. Wet-Barrel Fire Hydrants:

1. AWWA C503, freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet; interior coating according to AWWA C550.
2. UL 246, freestanding, one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.

2.11 FIRE DEPARTMENT CONNECTIONS

A. Fire system base water supply must provide a minimum of 1000 gpm (3785 l/m) at 150 psi (1035 kPa) and 700 gpm (2650 l/m) at 200 psi (1380 kPa) at the Fire Department connection. For hydraulic calculations, the calculated demand shall not fall less than 10 percent below the water supply curve.

B. Fire Department connections: UL 405, NFPA 1963, freestanding, cast bronze body, thread inlets, and matching local fire department hose threads, threaded bottom outlet, lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18 inch (460 mm) high brass sleeve; round escutcheon plate, meeting the requirements of UL 405.

1. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) outlet
2. Connections: Three NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet
3. Connections: Six NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet
4. Inlet Alignment: Inline
5. Finish Including Sleeve: Polished chrome-plated
6. Escutcheon Plate Marking: “AUTO SPKR” & “STANDPIPE”

2.12 ALARM DEVICES

A. Alarm Devices-General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psi (1725-kPa) working pressure; designed for horizontal or vertical installation; 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

2.13 DISINFECTION CHLORINE

A. Liquid chlorine: AWWA B301.

B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.

C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets, and shall contain 65 percent chlorine by weight.

2.14 WARNING TAPE

A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, detectable type, blue with black letters and imprinted with “CAUTION BURIED WATER LINE BELOW”.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Use pipe, fittings, and joining methods for piping systems according to the following applications.

1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
2. Do not use flanges or unions for underground piping.
3. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

B. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be the following:

1. Soft copper tube with wrought-copper.

C. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:

1. Soft copper tube with wrought-copper, solder-joint fittings; and brazed joints.

2. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.
3. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
4. PVC, AWWA Class 150 pipe for NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150) PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 fabricated or molded fittings; and gasketed joints.
5. PVC, AWWA Class 200 pipe for NPS 8 (DN 200): PVC, AWWA Class 200 fabricated push-on-joint, ductile iron mechanical-joint, ductile iron fittings; and gasketed joints.

D. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be any of the following:

1. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.
2. PE, Class 150, fire-service pipe; molded PE fittings; and heat-fusion joints.
3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.

3.2 VALVE APPLICATIONS

A. Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, non-rising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, non-rising-stem, metal resilient high-pressure, resilient -seated gate valves with valve box.
2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast iron, non-rising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:
   a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, non-rising stem.
   b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, metal seated .
   c. Check Valves: AWWA C508 UL/FMG, swing type.

3.3 DUCTILE IRON PIPE

A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
   1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105/A21.5.

B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.

C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.

D. Push on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead.

3.4 PVC PIPE

A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe.

B. Install Copper Tracer Wire, No. 14 AWG solid, single conductor, insulated. Install in the trench with piping to allow location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder per ASTM 828. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 1000 feet (300 m) provide a 5-pound (2.3 kg) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall also be attached at the end of each line.

3.5 ANCHORAGE INSTALLATION

A. Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include: concrete thrust blocks, locking mechanical joints, set-screw mechanical retainer glands, bolted flanged joints, heat-fused joints, or pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
   1. Gasketed-Joint, Ductile Iron, Water-Service Piping: According to AWWA C600.
   2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
   3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Valves: Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Valves: Install each underground valve and valves in vaults with stem pointing up and with vertical cast iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

E. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.7 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire department connection to mains.

B. Install protective pipe bollards on two sides of each fire department connection.

3.8 FIRE HYDRANT INSTALLATION

A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Install Wet-Barrel Fire Hydrants with valve below frost line. Provide for drainage.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Install water service lines to a point of connection within approximately 5 feet (1500 mm) outside of building(s) to which service is to be connected and make connections thereto. If building services have not been installed provide temporary caps and mark for future connection.

3.10 FIELD QUALITY CONTROL

A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour

per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare reports of testing activities.

3.11 IDENTIFICATION

A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

3.12 CLEANING

A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

B. Use purging and disinfecting procedure prescribed by local utility provider or other authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

C. Prepare reports of purging and disinfecting activities.

--- E N D ---

SECTION 33 30 00
SANITARY SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and procedures for construction of outside, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures, and all other incidentals.

1.2 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTHWORK (Short Form).

B. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATION.

D. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DEFINITIONS

1.4 ABBREVIATIONS

A. PVC: Polyvinyl chloride plastic

B. DI: Ductile iron pipe

1.5 DELIVERY, STORAGE AND HANDLING

A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

B. Handle manholes according to manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate connection to sanitary sewer main with Public Utility company. (Approval from public utility has been obtained indicating that the downstream sanitary systems have sufficient capacity to handle the sanitary discharge from the facility.)

B. Contractor to obtain approval from the Public Agency that the existing sanitary sewer systems have the capacity to handle the discharge from the facility.

C. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.

D. Coordinate connection to public sewer system with Public Utility Company.

1.7 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.8 SUBMITTALS:

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps and Ladders.

1.9 APPLICABLE PUBLICATIONS

Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A74-09.....Cast Iron Soil Pipe and Fittings

A185/A185M-07 .....Steel Welded Wire Reinforcement, Plain, for Concrete

A615/A615M-09b .....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A746-99.....Ductile-Iron Gravity Sewer Pipe

C478-09.....Precast Reinforced Concrete Manhole Sections

C857-11 ..... Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C890-11 ..... Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

C913-08 ..... Precast Concrete Water and Wastewater Structures

C923-08 ..... Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

C924-02(2009) ..... Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

C990-09 ..... Joints for Concrete Pipe, Manholes, and precast Box Sections using Preformed Flexible Joint Sealants

C1173-10 ..... Flexible Transition Couplings for Underground Piping Systems

C1440-08 ..... Thermoplastic Elastomeric (TPE) Gasket Materials for Drain, Waste and Vent (DWV), Sewer, Sanitary and Storm Plumbing Systems

C1460-08 ..... Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground

C1461-08 ..... Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste and Vent (DWV), Sewer, Sanitary and Storm Plumbing systems for Above and below Ground Use

D2321-11 ..... Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D3034-08 ..... Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

F477-10 ..... Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679-08 ..... Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

F891-10 ..... Coextruded Poly(vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core

F949-10 ..... Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

F1417-11 ..... Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

F1668-08 ..... Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C105/A21.5-10 ..... Polyethylene Encasement for Ductile-Iron Pipe Systems

C110-08 ..... Ductile-Iron and Gray-Iron Fittings

C111/A21.11-06 ..... Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings

C151/A21.51-09 ..... Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-06 ..... Ductile Iron Compact Fittings for Water Service

C219-11 ..... Bolted, Sleeve-Type Couplings for Plain-End Pipe

C512-07 ..... Air Release, Air/Vacuum and Combination Air Valves for Water Works Service

C600-10 ..... Installation of Ductile-Iron Mains and Their Appurtenances

C900-07 ..... Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

D. American Society of Mechanical Engineers:

A112.14.1–2003 ..... Backwater Valves

A112.36.2M-1991 ..... Cleanouts

1.10 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance.

Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

B. All pipe and fittings used in the construction of force mains shall be rated to meet the system maximum operating pressure with a minimum of 150 psi (1035 kPa).

C. The Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PVC, GRAVITY SEWER PIPE AND FITTINGS

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings shall conform to ASTM D3034 SDR 35.
2. Gaskets: ASTM F477.

B. PVC Cellular-Core Sewer Piping:

1. Pipe and Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D3034 SDR 35.

C. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F949, corrugated pipe with bell and spigot ends.
2. Fittings: ASTM F949.
3. Gaskets: ASTM F477.

D. PVC Type PSM Sewer Piping:

1. Pipe shall conform to ASTM D3034 SDR 35 .
2. Fittings: ASTM D3034.
3. Gaskets: ASTM F477.

2.3 PVC PRESSURE (FORCE) MAIN:

A. Joints shall be fully restrained with mechanical joints, capable of restraining 50 percent above all loads acting on the joint, but not less than 150 psi (1035 kPa). Thrust blocks shall not be permitted.

B. Ductile iron pipe and fittings: AWWA C151.

1. Push-on joints shall be restrained by a mechanical restraint and prevent the opening of the joint.

C. Polyvinyl Chloride (PVC) Pipe and Fittings:

1. Pipe: ASTM D3034, SDR 35.
2. Gaskets: ASTM F477.

2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal.
2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Couplings shall be elastomeric sleeve with stainless steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Couplings shall meet ASTM C1460 with elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Coupling shall be ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling, molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 PRESSURE-TYPE PIPE COUPLINGS

A. Tubular-Sleeve Couplings:

1. Couplings shall meet AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

B. Metal, bolted, sleeve-type, reducing or transition couplings for joining underground pressure piping:

1. Couplings shall meet a 150-psi (1035-kPa) minimum pressure rating and ends of same sizes of the main line piping.

C. Center-Sleeve Material:

1. Sleeve shall be Manufacturer's standard.

D. Gasket material: Gaskets shall be natural or synthetic rubber.

E. Metal component finish: Finish shall be a corrosion-resistant material or coating.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

B. PVC Cleanouts:

1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

2.7 MANHOLES

A. Standard precast concrete manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections or cast-in-place concrete.

1. Precast Concrete Manholes: Material shall be as per ASTM C478, precast, reinforced concrete, of depth indicated, with sealed joints.
2. Concrete Base: Concrete for base of manhole shall have a minimum compressive strength of 5000 psi (35 MPa) at 28 days. Thickness to be 8 inches (200 mm), minimum.
3. Riser Section: 4 inch (100 mm) minimum thickness, of lengths to provide the total depth of manhole.
4. Top Section: Eccentric-cone type unless otherwise indicated. Top section to match adjustment ring configurations.
5. Joint Sealant: ASTM C990.
6. Resilient Pipe Connectors: ASTM C923.
7. Steps: If over 60 inches (1500 mm) in depth, individual FRP steps or ladder ASTM A615 deformed, 1/2 inch (13 mm) steel reinforcing rods encased in precast concrete sections, with 16 inch (400 mm) minimum width, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.

8. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

2.8

2.9 WARNING TAPE

A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters and imprinted with “CAUTION BURIED SEWER LINE BELOW”.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's wr

C. itten instructions for using lubricants, cements, and other installation requirements.

D. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

E. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.

F. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.

G. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.

I. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe

J. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

K. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

L. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.

M. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping with minimum cover as shown on Drawings.
3. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.

N. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fittings, or cast-in-place-concrete supports or anchors. Pressure (force) mains shall have the bells facing the direction of flow.
2. Sections of piping listed on the drawings shall be fully restrained. For devices with twist off nuts, the twist off nuts shall be placed on top of the fitting for the Resident Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the Resident Engineer.
3. Thrust blocks shall not be permitted.

O. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

P. Gravity Flow Lines with Secondary Containment (Encasement Pipe):

1. Install per manufacturer's recommendations. Install all pipe centering devices to maintain an interstitial space below the invert of the carrier pipe. Both the carrier and containment pipe shall be tested for leaks.

3.2 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to the following:

1. Join PVC piping according to ASTM D2321.

B. Join force-main, pressure piping according to the following:

1. Join PVC pressure piping according to manufacturer's recommendations.
2. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

a. Flexible couplings for pipes of same or slightly different OD.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.3 BUILDING SERVICE LINES

A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

3.4 MANHOLE INSTALLATION

A. Install manholes complete with appurtenances and accessories indicated.

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.

2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed as per manufacturer’s recommendations. Adjust the length of the rings so that the top section will be at the required elevation. Cutting the top section is not acceptable.

3. Concrete manhole risers and tops: Install as specified.

B. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

C. Install steps and ladders per the manufacturer’s recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade.

E. Install manhole frames and covers on a mortar bed, such that frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. Install an 8 inches (200 mm) thick, by 12

inches (300 mm) wide concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches (150 mm) in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.

C. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 2 inches (50 mm) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 24 inches (600 mm) in diameter.

D. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

E. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.6 CONNECTIONS

A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe and grout the interstitial space between the pipe and the core.

B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.

C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous materi
4. al that may accumulate.

3.7 REGRADING

A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure and shall prevent debris from entering the wastewater stream.

3.8 PIPE SEPARATION

A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:
   a. Local conditions prevent a lateral separation of 10 feet (3 m); and

b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.

3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches (600 mm) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

3.9 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.10 FIELD QUALITY CONTROL

A. All systems shall be inspected and obtain the Resident Engineer's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.

4. Re-inspect and repeat procedure until results are satisfactory.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Test plastic gravity sewer piping according to ASTM F1417.

2. Test concrete gravity sewer piping according to ASTM C924.

3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.

4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).

5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.

6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

3.11 CLEANING

A. Clean dirt and superfluous material from interior of piping.

--- E N D ---

SECTION 33 40 00
STORM SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTHWORK (SHORT FORM).

B. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

C. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

D. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DEFINITIONS

1.4 ABBREVIATIONS

A. HDPE: High-density polyethylene

B. PE: Polyethylene

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Handle manholes, catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.

B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.7 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.8 SUBMITTALS

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings, and appurtenances, including jointing materials, hydrants, valves, and other miscellaneous items.

1.9 APPLICABLE PUBLICATIONS

Note: From the date contract documents are provided, the Contractor shall use the most current published versions of all listed standards and references below.

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A185/A185M-07 .....Steel Welded Wire Reinforcement, Plain, for Concrete

A242/A242M-04(2009) .....High-Strength Low-Alloy Structural Steel

A536-84(2009) .....Ductile Iron Castings

A615/A615M-09b .....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A760/A760M-10 .....Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

A798/A798M-07 .....Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications

A849-10.....Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe

A929/A929M-01(2007) .....Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe

B745/B745M-97(2005) .....Corrugated Aluminum Pipe for Sewers and Drains

B788/B788M-09.....Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe

C14-07 .....Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe

C33/C33M-08 ..... Concrete Aggregates

C76-11 ..... Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C139-10 ..... Concrete Masonry Units for Construction of Catch Basins and Manholes

C150/C150M-11 ..... Portland Cement

C443-10 ..... Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C478-09 ..... Precast Reinforced Concrete Manhole Sections

C506-10b ..... Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe

C507-10b ..... Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

C655-09 ..... Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

C857-07 ..... Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C891-09 ..... Installation of Underground Precast Concrete Utility Structures

C913-08 ..... Precast Concrete Water and Wastewater Structures

C923-08 ..... Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

C924-02(2009) ..... Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

C990-09 ..... Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

C1103-03(2009) ..... Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1173-08 ..... Flexible Transition Couplings for Underground Piping Systems

C1433-10 ..... Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

C1479-10 ..... Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

D448-08 ..... Sizes of Aggregate for Road and Bridge Construction

D698-07e1 ..... Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))

D1056-07 ..... Flexible Cellular Materials—Sponge or Expanded Rubber

D1785-06 ..... PolyVinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

D2321-11 ..... Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2751-05 ..... Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

D2774-08 ..... Underground Installation of Thermoplastic Pressure Piping

D3034-08 ..... Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D3350-10 ..... Polyethylene Plastics Pipe and Fittings Materials

D3753-05e1 ..... Glass-Fiber-Reinforced Polyester Manholes and Wetwells

D4101-11 ..... Polypropylene Injection and Extrusion Materials

D5926-09 ..... Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

F477-10 ..... Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679-08 ..... Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

F714-10 ..... Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F794-03(2009) ..... Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

F891-10 ..... Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core

F894-07 ..... Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F949-10 ..... Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

F1417-11 ..... Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

F1668-08 ..... Construction Procedures for Buried Plastic Pipe

C. American Association of State Highway and Transportation Officials (AASHTO):

M190-04..... Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches

M198-10..... Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

M252-09..... Corrugated Polyethylene Drainage Pipe

M294-10..... Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter

D. American Water Works Association (AWWA):

C105/A21.5-10 ..... Polyethylene Encasement for Ductile iron Pipe Systems

C110-08 ..... Ductile-Iron and Gray-Iron Fittings

C219-11 ..... Bolted, Sleeve-Type Couplings for Plain-End Pipe

C600-10 ..... Installation of Ductile iron Mains and Their Appurtenances

C900-07 ..... Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

M23-2nd ed..... PVC Pipe ”Design And Installation”

E. American Society of Mechanical Engineers (ASME):

A112.6.3-2001..... Floor and Trench Drains

A112.14.1-2003..... Backwater Valves

A112.36.2M-1991 .....Cleanouts

F. American Concrete Institute (ACI):

318-05 .....Structural Commentary and Commentary

350/350M-06 .....Environmental Engineering Concrete Structures and Commentary

G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.10 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PE PIPE AND FITTINGS

A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.

B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); ASTM F714, SDR 21 for pipes 3 to 24 inches (300 to 600 mm) with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
3. Watertight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, Class 160.

1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, gasket weld type with integral bell.

D. PVC Pipe And Fittings

1. PVC Cellular-Core Pipe And Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D3034, SDR 35, PVC socket-type fittings.

E. PVC Corrugated Sewer Piping

1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F477, elastomeric seals.

F. PVC Profile Sewer Piping

1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

G. PVC Type PSM Sewer Piping

1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

H. PVC Gravity Sewer Piping

1. Pipe and fittings shall be ASTM F679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends.
2. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

2.3 CONCRETE PIPE AND FITTINGS

A. Non-Reinforced-Concrete sewer pipe and fittings shall be ASTM C14, Class 1 , with bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets .

B. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets sealant joints with ASTM C990, bitumen or butyl-rubber sealant.
2. Class I: Wall A

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials

1. For concrete pipes: ASTM C443, rubber.
2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psi (1725-kPa) minimum working pressure and for offset and expansion indicated.

B. Ductile iron expansion joints: Three-piece assemblies of telescoping sleeve with gaskets and restrained-type, ductile iron or steel with protective coating, bell-and-spigot end sections complying with AWWA C110. Include rating for 250-psi (1725-kPa) minimum working pressure and for expansion indicated.

C. Ductile iron deflection fittings: Compound-coupling fitting, with ball joint, flexing section, gaskets, and restrained-joint ends, complying with AWWA C110. Include rating for 250-psi (1725-kPa) minimum working pressure and for up to 15 deg of deflection.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Heavy Duty
2. Pipe fitting and riser to cleanout shall be same material as main pipe line.

B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.7 DRAINS

A. Cast-Iron Area Drains: ASME A112.6.3, gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Top-Loading Classification(s): Heavy Duty

2.8 MANHOLES AND CATCH BASINS

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.

9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). Individual FRP steps or FRP ladder, spaced at 12 to 16 inch (300 to 400 mm) intervals.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.9 CONCRETE FOR MANHOLES AND CATCH BASINS

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6-inch slope from main line pipe to wall sides.

2.10 PIPE OUTLETS

A. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-3, screen opening 2 inches (51 mm).
2. Average Size: NSSGA No. R-4, screen opening 3 inches (76 mm).
3. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).

B. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

C. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

2.11 FLARED END SECTIONS

A. Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.12 PRECAST REINFORCED CONCRETE BOX CULVERT

A. Precast Reinforced Concrete Box Culvert: Designed for highway loadings with 2 feet (600 mm) of cover or more subjected to dead load only, conforming to ASTM C1433. For less than 2 feet (600 mm) of cover, subjected to highway loading, conform to ASTM C1433.

2.13 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.14 WARNING TAPE

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters, and imprinted with “CAUTION BURIED STORM DRAIN LINE BELOW”.

PART 3 - EXECUTION

3.1 PIPE BEDDING

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.2 PIPING INSTALLATION

A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping with minimum cover as shown on the Drawings.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and

couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fittings; or cast in-place concrete supports or anchors.
3. Install hub-and-spigot, cast iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
4. Install ductile iron piping and special fittings according to AWWA C600.
5. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.

6. Install non-reinforced-concrete and reinforced concrete sewer piping according to ASTM C1479.
7. Install force-main pressure piping according to the following:
   a. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fittings; or cast in-place concrete supports or anchors.
   b. Install ductile iron pressure piping and special fittings according to AWWA C600.
   c. Install PVC pressure piping according to AWWA M23, or ASTM D2774 and ASTM F1668.
   d. Install corrosion-protection piping encasement over the following underground metal piping according to AWWA C105/A21.5.
      1) Hub-and-spigot, cast iron soil pipe and fittings.
      2) Hubless cast iron soil pipe and fittings.
      3) Ductile iron pipe and fittings.
      4) Expansion joints and deflection fittings.

3.3 REGRADING

A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure and shall prevent debris from entering the wastewater stream.

3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Embed drains in 4 inch (102 mm) minimum concrete around bottom and sides.

C. Set drain frames and covers with tops flush with pavement surface.

D. Assemble trench sections with flanged joints and embed trench sections in 4 inch (102 mm) minimum concrete around bottom and sides.

3.6 MANHOLE INSTALLATION

A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.

B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

C. Circular Structures:

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:

a. Forming directly in concrete base of structure.

b. Building up with brick and mortar.

4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade. Install an 8 inch (203 mm) thick, by 12 inch (300 mm) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete.

B. Construct riprap of broken stone.

C. Install outlets that spill onto grade, anchored with concrete.

D. Install outlets that spill onto grade, with flared end sections that match pipe.

E. Construct energy dissipaters at outlets.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.

B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
a. Shielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

3.10 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edge of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

3.12 TESTING OF STORM SEWERS:

A. Submit separate report for each test.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.

4. Submit separate report for each test.

5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

6. Test force-main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).

a. Ductile iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.

b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

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