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100% Design Specifications

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Construct New Headhouse and Greenhouse
USDA-ARS, NCAUR
Peoria, Illinois

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DATE: April 7, 2026

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SECTION 01 10 00 – SUMMARY

PART 1 GENERAL

1.1 PROJECT INFORMATION

A. Project Name and Location:

1. Construct New Headhouse and Greenhouse

2. USDA-ARS, NCAUR, 1815 North University Street, Peoria, Illinois 61604

B. Project Summary Description. The Work of this Contract is defined by the Contract Documents and generally consists of, but is not limited to, the following:

1. Demolition: Site utilities and limited site improvements demo. Limited demo of interior finishes, removal and re-installation of interior finishes and limited MEP utilities demolition in the existing Building 1.

2. General: provide complete headhouse and greenhouse building structures, including utility chase way building structure connecting to the existing building, as indicated on drawings. Intent of Base Bid is to provide new structures on the existing USDA ARS NCAUR site in Peoria, Illinois. All headhouse and greenhouse spaces shall comply with the USDA's BSL-2P requirements and with USDA APHIS containment facility guidelines for fungal plant pathogens. The greenhouse building structure shall be a delegated design by the Contractor. The greenhouse and all MEP and other building systems shall be integrated to provide a complete greenhouse and headhouse building to operate as indicated in the Contract Documents. The greenhouse structure will consist of a circulation space connecting to the headhouse and two greenhouse bays. A new above-grade utility chaseway building structure will connect the greenhouse to a remodeled space at the ground floor level of the existing Building 1, South wing lab building administration wing. The space within the existing building will be altered to be a mechanical room to serve the new headhouse and greenhouse.

3. Civil: existing sanitary sewer and storm sewer lines from the south wing are being rerouted west and south around the new greenhouse and future greenhouse footprint. There is a drainage swale in-between these two lines for the majority of surface flows. There is a storm sewer pipe entering an existing manhole that has unknown origin, and if encountered with installation of the new line, it needs to be connected. Sanitary service from the new greenhouse connects on the south side. Existing sidewalk and some trees are being removed, and new sidewalk is being rerouted around the east and south sides of the new greenhouse with sidewalk lighting. A 15-foot aggregate landscape buffer is entirely around the new greenhouse to reduce vegetation interaction potential.

4. Structural: foundations for the headhouse, greenhouse, and utility corridor will be poured in place concrete grade walls supported on shallow spread concrete footings. The headhouse structure shall consist of 8" CMU bearing walls supporting steel roof joists. The greenhouse will be a delegated design engineered structural system consisting of steel frames with gable roof trusses and beams and X-braced bays around the perimeter for lateral resistance. The utility chaseway building structure will be cold formed steel (CFS) load-bearing metal studs and roof joists forming a rigid frame system.

5. Mechanical: the existing medium pressure steam system will be extended from the penthouse to the ground floor mechanical room. A new PRV, condensate return station, heat exchanger, and pumps shall be provided in the ground floor mechanical room, and heating water will be extended to the greenhouse addition. The greenhouses will be served by several HVAC systems. Each greenhouse shall have a dedicated air handling system (DX cooling and electric heating). The greenhouses will also be served by new humidifiers. Hot water fin-tube radiation and hot water unit heaters will also be provided around the perimeter of the greenhouses. The headhouse and the circulating corridor will also be served by dedicated air handling systems. Each greenhouse will have a dedicated exhaust fan. The headhouse will have two exhaust fans, each with a dedicated filter. All of the new HVAC equipment will be connected to the existing temperature controls system.

6. Electrical: power for the new greenhouse and headhouse will be fed from new panels located in the headhouse. Normal power will originate from Vault 5 via a new underground duct bank. Emergency power will be fed from the electrical room in the central wing of the main building. Lighting will be provided with new LED grow lights and control system to meet the grow requirements of the researchers' experiments. The existing fire alarm system will be extended to cover the new greenhouse and headhouse.

7. Plumbing: a new 4" sanitary connection will be provided for the greenhouse addition. Holding tanks will be provided in each greenhouse below grade to serve the floor drain in the greenhouse. The existing domestic water system for the building will be extended to the greenhouse addition. A new 3" cold water connection will be made in the existing Building 1 penthouse and routed down through the existing building to the new addition. A new 1 ½" deionized water connection will also be made in the penthouse and routed down through the building to the new addition. A new electric water heater will be provided in the headhouse to serve the greenhouse addition. The new domestic hot water system will be recirculated. Domestic hot water and cold water will be routed through the new spaces to serve the new fixtures. Provisions are included in the piping systems to allow for expansion to the west for future greenhouses.

8. IT: existing data network will be extended to the greenhouse from first level comm room 1314 with fiber connections. Existing copper/phone lines will be extended to the greenhouse from 2nd level comm room 2100 from an existing wall field with a new copper backbone cable. The existing access control system will be extended with a new control panel installed in the greenhouse. Existing house paging system will be tapped to extend from the main building into the greenhouse.

9. Reference also the Project Description, Sheet G100 for additional information.

C. Architect/Engineer: The term Architect/Engineer refers to the project designer. The Architect/Engineer's status relative to the construction will be stated in writing by the Contracting Officer prior to the pre-construction conference. The project was designed by:

Bailey Edward Design, Inc.
35 E. Wacker Dr., Suite 800
Chicago, IL 60601
Attn: Pam Crowell
(312) 440-2300
pcrowell@baileyedward.com

D. Project Delivery Method: Traditional Bid-build

E. The Contracting Officer for the project is: Joshua J. Dobereiner
USDA, ARS, MWAAO
1815 North University Street
Peoria, IL 61604
(309) 403-3556 (office)
josh.dobereiner@usda.gov

F. Primary Contact – Contracting Officer's Rep: Chris Wilson
USDA, ARS
5601 Sunnyside Avenue
Beltsville, MD 20705
(301) 504-1208
Chris.Wilson2@usda.gov

1.2 WORK BY OTHER CONTRACTORS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

a. Data technology installation
b. Furniture and Equipment installation

1.3 MISCELLANEOUS PROVISIONS

A. Work in existing facilities shall correspond in all respects with the existing conditions to which it connects, or to similar existing conditions, in materials, workmanship and finish unless noted otherwise.

B. Alterations to Existing Conditions: Existing conditions shall be cut, drilled, removed, temporarily removed, or removed and replaced, as necessary for performance of Work under the Contract and in conformance with Health and Safety requirements outlined in section 01 59 50 - Safety and Health. Work out of alignment where exposed by removal of existing work shall be called to the attention of USDA-ARS. Necessary corrective work shall be as directed.

1. Replacements of existing conditions that are removed shall match similar existing conditions.

2. Unless otherwise indicated, existing structural members shall not be cut or altered without authorization by the Contracting Officer.

3. Adjacent work remaining in place, which are damaged or defaced during the Work, shall be restored to the condition existing at time of award of Contract to the satisfaction of the Government.

C. Existing structures will remain in place.

D. Removed items indicated to remain the property of the Government shall be stored in the building where directed by the Contracting Officer

E. Existing utility services with related meters and equipment will remain in place.

1.4 SCHEDULE OF GOVERNMENT-FURNISHED PROPERTY – NOT APPLICABLE

A. The project includes the following Government furnished property to be installed by the Contractor. The USDA-ARS will advise the Contractor when the equipment should be delivered.

1. Autoclave shown on Sheet A101. Contractor shall place in the building and install and make the utility connections.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01 10 00

SECTION 01 14 00 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 CONTRACTOR USE OF PREMISES

A. The Contractor will review and document the existing conditions surrounding the project premises. Provide documentation to USDA-ARS prior to the commencement of any construction activity.

B. The Contractor shall limit use of the premises to the work in areas indicated, and to allow for Government occupancy and public use.

1. Confine operations at the site to areas indicated in plans. Do not disturb portions of the site beyond the areas in which Work is indicated.

2. Keep driveways and entrances serving the premises clear and available at all times to the Government, Government employees and to visitors. Do not use these areas for parking or storage of materials.

3. Schedule deliveries to minimize space and time requirements for storage of material and equipment on site.

4. Maintain building operations in a safe and functional condition throughout the construction period. Repair damage caused by construction operations to the satisfaction of the government. Take precautions to protect the facility, its occupants, and the public during the construction period. A representative of the Contractor shall be available to arrive on site within one (1) hour of notice should an emergency occur.

5. Keep active roadways and work areas free from accumulation of waste material, rubbish, construction debris and construction materials.

6. Space on the premises will be made available for the Contractor's storage and related activities, provided that its use will not interfere with operations of the Government. Arrange and gain approval for use of this space through the Contracting Officer.

7. Use of the existing site access will be shared with Government activities on a first-come-first-served, wait-your-turn basis. The facility is available for the delivery of materials, tools, and supplies between 8 AM and 4:00 PM.

8. Existing materials and equipment that are removed as part of the construction operations, and that are not reused or designated to be salvaged as Government property, shall become the property of the Contractor, and shall be removed from the site. Storage or sale of excess salvageable materials and equipment is not permitted on site.

9. Pollution producing equipment shall not be located near air intakes where airborne smoke or fumes could be drawn into buildings. When not required for powering unloading operations, turn off engines when parked.

10. The contractor shall submit a silica work exposure plan that must be sufficient to minimize the release of visible dust and minimize the accumulation of visible airborne dust before commencing construction activities.

11. Smoking is not permitted in or around buildings, see Facilities Management Regulation (FMR) Case 2008-102—3. Also see Code of Federal Regulations (CFR) 41 CFR Part 102-74.

12. Parking shall be arranged in coordination with Site staff.

13. No apparatus with an open flame is allowed to be used within the port without the prior receipt of a burn permit. Contact the Field Office to obtain burn permits. Burn permits are required for each separate occurrence.

14. Permits: Refer to FAR 52.236-7

15. The work shall be sequenced to minimize disruption to building operations, visitors, and maintenance activities. To the greatest extent feasible, demolition work should not take place until supplies are on hand to perform new work.

16. Coordinate with the USDA-ARS Site Manager and the COR for site access.

17. Coordinate with the USDA-ARS Building Manager and the COR on correct response procedures for any building system alarms occurring during or resulting from the construction process.

18. All facility systems outside the immediate construction area shall be kept fully operational during normal working hours.

19. Protect adjacent buildings and site from flying debris.

20. There is space available for a dumpster on-site

1.2 GOVERNMENT OCCUPANCY

A. The USDA-ARS/other tenant agencies will occupy the site during the entire period of construction. Cooperate with the USDA-ARS during construction operations to minimize conflicts, mitigate noise, and facilitate Government usage. Perform the Work in a manner that does not interfere with the USDA-ARS (or other gov agencies) operations.

1.3 WORKING HOURS

A. Government Occupied Hours: Government personnel are scheduled to occupy the building during the following hours on weekdays, Monday through Friday, except for established Government Holidays, 8:00 AM to 5:00 PM.

B. Government Unoccupied Hours: Government personnel are not scheduled to occupy the building during times not indicated as Government Occupied Hours.

C. Contractor's General Working Hours: The Contractor working hours shall be generally established to occur during Government Occupied Hours.

D. Contractor's Required Working Hours: The following work shall be performed during Government Unoccupied Hours:

1. Noisy and/or odor-producing work that may disrupt tenant operations. Noisy work is defined as work producing decibel levels in excess of 60 dB outside the construction area.

2. Testing of Fire Alarm and Fire Sprinkler systems

3. Hot Work (Verify with the Government)

E. Work accomplished during Government Unoccupied Hours shall be performed at no additional cost to the Government. Contractor shall submit a proposed schedule and gain the Contracting Officer's approval at least 48 hours before proceeding with any work during Government Unoccupied Hours.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01 14 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Face Brick Exterior Cladding.

1. Base Bid: Fiber cement exterior wall panels as indicated on the Architectural Drawings.
2. Alternate: Face brick exterior wall cladding as indicated on the Architectural Drawings.

B. Alternate No. 2: Greenhouse Roof Shading System.
1. Base Bid: No shading system at the inside of the Greenhouse roof as indicated in the Drawings
2. Alternate: Add Shading system at the inside of the Greenhouse roof. Provide both a summer shading system and a winter/energy saving shading systems as indicated in the Architectural Drawings.

C. Alternate No. 3: Deionized Water System
1. Base Bid: No deionized water system as indicated in the Drawings
2. Alternate: Add a deionized water system, extended from an upper level of the existing Building 1 to the new Greenhouse bays as indicated on the MEP Drawings.

D. Alternate No. 4: Greenhouse Extended Height
1. Base Bid: New greenhouse at the height indicated in the Drawings
2. Alternate: Add an additional 4'-0" to the height of the greenhouse structure, glazed exterior walls, interior walls and all MEP systems as indicated in the Architectural Drawings. The delegated design engineering of the Greenhouse structure and glazed shall accommodate all required loading for the increase in height.

E. Alternate No. 5: CO2 System
1. Base Bid: No CO2 system as indicated in the Drawings
2. Alternate: Add a new CO2 system including, but not limited to a concrete pad, fencing, bollards, CO2 tank and CO2 piping as shown on Sheets C200, and P300 and as indicated in the Drawings.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The Government is providing the references included in this subsection for information purposes only and is not intended to provide a comprehensive, all-inclusive list of any and all potentially relevant portions of the Contract Documents. Drawings and general provisions of the Contract and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:

1. Division 01 60 00 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Proposed changes to the Contract Documents by the Contractor for products, materials, equipment, and methods of construction.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms

2. Substitutions for Convenience: Changes proposed by Contractor or USDA-ARS that are not required in order to meet other Project requirements but may offer advantage to Contractor or USDA-ARS

1.4 SUBMITTALS for Cause or Convenience:

A. Substitution Requests: Per Submittal Procedures Section 01 33 00 submit electronic copies through PMIS of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form**:** CSI Substitution Request Form 1.5C

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Government and separate contractors that will be necessary to accommodate proposed substitution.

b. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, energy and resource performance goals, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

d. Samples, where applicable or requested.

e. Certificates and qualification data, where applicable or requested.

f. List of similar installations for completed projects with project name, location and contact information of owner and architect/engineer of record.

g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

h. Research reports evidencing compliance with building code in effect for the project, when applicable for the proposed substitution.

i. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery. Provide a schedule fragment with a time impact analysis to allow the Government to consider the proposed substitution.

j. Cost information, including a proposal of change, if any, in the Contract Sum.

k. Proposed substitution complies with requirements in the Contract Documents except as indicated in the substitution request, is compatible with related materials, and is appropriate for applications indicated.

l. The Contracting Officer may require the Contractor to provide a contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. The Contracting Officer or Contracting Officer's Representative (CO) or (COR) Action: If necessary, the Contracting Officer or COR will request additional information or documentation for evaluation. The Contractor shall be entitled to receive notice of action on submittals within a reasonable time, given the volume or complexity of the submittals and the criticality of the affected activities to Substantial Completion as may be indicated in the Project Schedule. The Contractor shall not be entitled to receive notice of action on submittals containing variations from Contract requirements in less than twenty working days. (Coordinate with 01 33 00 Submittals).

B. Failure by the government to respond does not constitute acceptance of the proposed substitution.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agencies to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 20 working days prior to time required for preparation and review of related submittals.

1. Conditions: The Contracting Officer (CO) will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, the CO will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Substitution request is fully documented and properly submitted.

c. If requested substitution involves schedule impact Contractor has identified time impact and a mitigation plan. .

d. Requested substitution has received necessary approvals of authorities having jurisdiction.

e. Requested substitution is compatible with other portions of the Work.

f. Requested substitution has been coordinated with other portions of the Work.

g. Requested substitution provides specified warranty.

h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience the Contracting Officer (CO) will consider requests for substitution if received within 30 days of contract award, submittals received after that time may be considered or rejected at discretion of the CO or the Contracting Officer's Representative (COR).

1. Conditions: The CO will consider Contractor's request for substitution when the following conditions are satisfied.

a. Requested substitution offers the Government a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional obligations the Government incurs.

b. Requested substitution does not require extensive revisions to the Contract Documents.

c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

d. Substitution request is fully documented and properly submitted.

e. Requested substitution has received necessary approvals of authorities having jurisdiction.

f. Requested substitution is compatible with other portions of the Work.

g. Requested substitution has been coordinated with other portions of the Work.

h. Requested substitution provides specified warranty.

i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and to process Requests for Payment.

1.2 DEFINITIONS

A. Schedule of Values: A detailed written statement (masterformat) furnished by the Contractor outlining the portions of the contract sum, which allocates values (price & percentage) for the various parts of the work and used as the basis for payment application and reviewing progress payments. The Agreement provides further details.

B. Request for Payment: A contractor's invoice and request for progress payment with substantiating information consistent with approved schedule of values.

1.3 SUBMITTALS - SCHEDULE OF VALUES

A. Coordination: Submit completed Schedule of Values no later than 14 calendar days prior to the scheduled date of initial Requests for Payment. No payment request will be accepted without an approved schedule of values.

B. Schedules for Phased Work: Where the work is separated into phases, provide Schedules showing values correlated with each phase using the standard format referenced below.

C. Format and Content: Contractor shall be responsible to complete the USDA-ARS Schedule of Values Workbook and compile the values into USDA-ARS's Project Management System. Contractor will enter values into the workbook prior to USDA-ARS's Project Management System input and provide associated electronic baseline copy to the contracting officer for record. If approved by the COR, the contractor may use the AIA G702/G703 format instead of the USDA-ARS Schedule of Values Workbook. Contractor will follow guidelines in the Schedule of Values workbook to support USDA-ARS's Project Management System upload.

1. Identification: Complete the following Project Identification fields in the Schedule of Values:

a. Project Name

b. Project Number

c. Project Location, City, State

d. Base Contract Number

e. Task Order Number

f. Modification Number

g. USDA-ARS Project Manager

h. Contractor's Name and contact information

i. Date of submittal

2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Requests for Payment and progress reports.

a. Work activity – (Divided by division or specific work activity) Work activities shall be further divided into separate line items for labor and materials.

b. Dollar value of each specific work activity – both with an amount in dollars and whole cents, and as a percentage of the Contract Sum to nearest one-hundredth percent. Adjust the amounts to total to the Contract Sum and the percentages to total 100 percent.

c. Phased work shall be divided into different phases within the SOV with each phase having a subtotal row.

d. Modifications that affect value.

e. Line item for mobilization and demobilization

f. Line item for punchlist and closeout (5% of total contract value for single phase project or 5% of phase value for phased projects)

g. Options: Provide a separate heading in the Schedule of Values for each exercised Option.

1.4 REQUESTS FOR PAYMENT

A. Requirements for Requests for Payment are in Section III, Terms and Conditions of the Agreement.

B. Each Request for Payment following the initial Request for Payment shall be consistent with previous Requests.

1. Initial Request for Payment, Request for Payment at time of Substantial Completion, and final Request for Payment involve additional requirements.

C. Payment Request Times: Submit Request for Payment to USDA-ARS monthly. The period covered by each Request for Payment is one month.

1. Submit one paper draft copy (aka pencil copy) of Request for Payment to the CO or enter in USDA-ARS's Project Management System along with construction progress report *7 calendar* days prior to the due date for review by USDA-ARS. Provide documentation evidencing the cost of work performed to be included in the Request for Payment. Resolve questions resulting from USDA-ARS review of draft Request for Payment and construction progress report prior to submitting Request for Payment.

2. The USDA-ARS shall review the Contractor's monthly request for payment based upon the current approved Schedule Update. The USDA-ARS will consider the Contractor's overall progress toward Project Completion along with the progress for discrete activities to determine the amount to be approved for the monthly payment request.

3. USDA-ARS may withhold payment for reasons including but not limited to: unacceptable construction progress, failure to comply with schedule update requirements, and/or failure to provide required submittals in a timely manner.

D. Request Preparation: All payments must be executed by a person authorized to legally bind the Contractor.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

2. Include amounts for work completed following the effective date of the previous Request for Payment, whether or not payment has been received. Include only amounts for work completed as of effective date of current Request for Payment.

3. Include waste manifests for work performed during the period in accordance with the approved waste management plan.

4. Include signed USDA-ARS 2419 form

5. Include copies of certified payrolls for work performed during the period.

6. Include amounts of Modifications issued before the last day of the construction period covered by Request.

E. Stored Materials: Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies the amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation.

3. Provide summary documentation for stored materials indicating the following:

a. Value of materials previously stored and remaining stored as of the effective date of previous Request for Payment.

b. Value of previously stored materials put in place after the effective date of previous Request for Payment and on or before the effective date of the current Request for Payment.

c. Value of materials stored since effective date of previous Request for Payment and remaining stored as of effective date of current Request for Payment.

F. Initial Request for Payment: Administrative actions and submittals that must be approved prior to the submittal of first Request for Payment include the following:

1. Schedule of values (see 01 29 00)

2. Contractor's construction schedule (see 01 31 20)

3. Schedule of unit prices (if applicable).

4. Submittal schedule (see 01 33 00)

5. List of Contractor's staff assignments (see 01 31 00)

6. Fire Safety Plan (see 01 35 25)

7. Health and Safety Plan (see 01 59 30)

8. Waste Management Plan (see 01 74 19)

9. Fire Alarm Submittal (see 28 31 00)

10. Copies of building permits, if applicable.

11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work, if applicable.

G. Request for Payment at Substantial Completion: After USDA-ARS issues the Notice of Substantial Completion, submit a Request for Payment less previous payments made for portions of the Work claimed as substantially complete.

1. Include documentation supporting the claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This Request shall reflect Notices of Substantial Completion issued previously for USDA-ARS occupancy of designated portions of the Work.

H. Final Payment Request: The Agreement provides further details

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SUMMARY

A. This section includes certain administrative provisions for managing and coordinating construction operations, including but not limited to the following:

1. General project coordination.
2. Coordination drawings.
3. Conservation.
4. Administrative and supervisory personnel.
5. Conferences and meetings.
6. Requests for Information (RFIs)
7. Utility service interruptions.
8. Cleaning and protection.

1.2 GENERAL PROJECT COORDINATION

A. Coordination of Trades: Coordinate construction operations included in the various sections of the Specifications to provide an efficient and orderly installation of each part of the Work. Coordinate construction operations included under different sections of the Specifications that depend on each other for proper installation, connection or operation. Keep pipes, ducts, conduit, and the like as close as possible to ceiling slab, walls, and columns to take up a minimum amount of space. Locate pipes, ducts, and equipment so that they do not interfere with the intended use of eyebolts and other lifting devices. Assure all controls can be reached and operated.

1. Schedule construction operations in the sequence required to obtain the best results where the installation of one part of the Work depends on installation of other components before or after that part.
2. Coordinate installation of different components to provide maximum accessibility for required maintenance, service, testing and repair.
3. Minimize roof penetrations.

B. Notification: Prepare and distribute memoranda to each party involved, outlining special procedures required for coordination. Include notices, reports and meeting minutes as part of the memoranda.

C. Administrative Procedures: Coordinate scheduling and timing of administrative procedures with other construction activities to avoid conflicts and promote orderly progress of the Work. Administrative procedures include but are not limited to the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.

3. Telecommunication, data, internet and other tele-work systems for USDA-ARS, tenants and/or end users.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Project closeout activities.

7. Startup and adjustment of systems.

1.3 CONSERVATION

A. Coordinate conservation of energy, water and materials in the conduct of construction operations. Salvage materials and equipment involved in the performance of, but not incorporated into, the Work.

B. Comply with Green Purchasing Plan requirements.

1.4 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. The Contractor shall provide administrative and supervisory personnel for proper performance of the Work including but not limited to a project manager and a superintendent. These individuals shall each have at least 5 years of experience in their respective role in a similar project.

B. Safety and Health Officer: The contractor have a safety and health officer whose duties shall consist of developing and implementing safety and health programs specified in Division One 01 59 50 Safety and Health

1.5 CONFERENCES AND MEETINGS

A. Post Award Conference: The government shall a post award conference within 2 weeks of award at a time and place convenient to the Government. The preconstruction conference shall review responsibilities and personnel.

1. Attendees: Participants at the conference shall be familiar with the project, shall be authorized to conclude matters relating to the Work, and shall minimally include representatives of the following parties:

a. USDA-ARS representatives

b. A/E Design Team

c. Contractor

2. Agenda: Subjects for discussion shall include items of significance that could affect progress, including but not limited to the following:

a. Introduction of project team and roles

b. Review of Government Policies and Procedures

c. Security Clearance Procedures

d. Submittal Procedures

e. Project Communications

f. Change Order Procedures

g. RFI Procedures

h. Access Requests

B. Progress Meetings: The Government or designee shall conduct progress meetings virtually or at the Project Site at regular intervals (either weekly or bi-weekly from award until completion).

1. Attendees: Regular attendees shall include government representative, contractor representative, and A/E representatives. Occasionally a subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented on an as needed basis. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

2. Agenda:

a. Contractor's Construction Schedule: Review progress since the last progress meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Provide 2 week schedule look ahead.

b. Review the present and future needs of each entity present, including but not limited to the following:

1) Status of Submittals - Contractor shall provide an updated submittal schedule prior to each meeting.

2) Security Clearance Status

3) Access Requests

4) Open Change Orders

5) Open RFIs

6) Open Items

7) New Business

8) At this meeting or a separate meeting prior to the onsite notice to proceed, additional items including but not limited to the following shall be reviewed:
   a) Payment Procedures
   b) Weekly Reports
   c) Sign in Forms
   d) Building Access Procedures
   e) Tenant Coordination on Access and/or existing security

2. Schedule Updating: The Contractor shall revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. The revised schedule shall be issued to the A/E within 2 business days of the meeting to be issued concurrently with the report of each meeting.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity/major assemblies if the Work requires tight control and coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow shall attend the meeting. Advise USDA-ARS, Commissioning Agent, COR, and Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Modifications.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. LEED requirements and sustainable design requirements.
   i. Review of mockups.
   j. Possible conflicts.

k. Compatibility problems.

l. Time schedules.

m. Weather limitations.

n. Manufacturer's written recommendations.

o. Warranty requirements.

p. Compatibility of materials.

q. Acceptability of substrates.

r. Temporary facilities and controls.

s. Space and access limitations.

t. Regulations of authorities having jurisdiction.

u. Testing and inspecting requirements.

v. Installation procedures.

w. Coordination with other work.

x. Required performance results.

y. Protection of adjacent work.

z. Protection of construction and personnel.

aa. Structural limitations and temporary loading.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate actions necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Meetings with Tenants/Representative: The Contractor shall conduct meetings with affected building tenants/representatives at appropriate construction phase intervals, to address upcoming construction operations and coordination procedures in order to avoid potential problems and misunderstandings.

1. Frequency of Meetings: On an as-needed basis per anticipated construction phase interval.

2. Attendees: In addition to the Contractor, the COR, the building manager, Project Manager and/or COR, the affected tenants and/or their representative(s) or any other entity involved in the coordination or planning of construction activities shall be represented.

3. Agenda: Review and address upcoming construction operations and coordination procedures for the affected tenants, as well as address any outstanding concerns or issues the tenants may have.

4. Reporting: No later than 3 calendar days after each meeting, the Contractor shall distribute minutes of meeting to each party present and to other concerned parties, including the Contracting Officer.

E. Project Closeout Conference: USDA-ARS will schedule and conduct a Project closeout conference, at a time convenient to the Government, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Attendees: Authorized representatives of USDA-ARS, Architect, Contractor and its superintendent; shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.

b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.

c. Requirements for preparing operations and maintenance data.

d. Requirements for delivery of material samples, attic stock, and spare parts.

e. Requirements for demonstration and training.

f. Preparation of Contractor's punch list.

g. Procedures for processing Applications for Payment at Substantial Completion and for final payment.

h. Submittal procedures.

i. Coordination of separate contracts, if any.

j. USDA-ARS's partial occupancy requirements.

k. Installation of USDA-ARS's furniture, fixtures, and equipment.

l. Responsibility for removing temporary facilities and controls.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI to USDA-ARS/COR in the form specified.

1. COR will return RFIs submitted by other entities controlled by Contractor, with no response.

2. Coordinate, submit, and respond to RFIs in a prompt manner so as to avoid delays in the Work.

B. Content of Contractor-Initiated RFIs: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. USDA-ARS Project number.

3. Date.

4. Name of Contracting Officer.

5. Name of COR.

6. Name of Architect.

7. Name of Contractor.

8. RFI number(s). If including multiple numbers, organize them sequentially.

9. RFI subject.

10. Specification Section number and title and related paragraphs, as appropriate.

11. Drawing number and detail references, as appropriate.

12. Field dimensions and conditions, as appropriate.

13. Contractor's suggested resolution. If Contractor's recommended resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, product data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Form acceptable to USDA-ARS.

D. COR and USDA-ARS Action: COR will review each RFI. COR will forward RFI to Architect. COR in conjunction with Architect will determine action required, and respond through COR. Allow seven working days for USDA-ARS's/Architects' response for each RFI. RFIs received by COR after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

a. Requests for approval of submittals.

b. Requests for approval of substitutions.

c. Requests for approval of Contractor's means and methods.

d. Requests for coordination information already indicated in the Contract Documents.

e. Requests for adjustments in the Contract Time or the Contract Sum.

f. Requests for interpretation of USDA-ARS's actions on submittals.

g. Incomplete RFIs or inaccurately prepared RFIs.

2. USDA-ARS's action may include a request for additional information, in which case USDA-ARS's time for response will date from time of receipt of additional information.

E. RFI Log: Contractor will maintain a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.

2. USDA-ARS Project number.

3. Name of Contracting Officer.

4. Name of Contractor.

5. Name of Architect.

6. Name of COR.

7. RFI number including RFIs that were returned without action or withdrawn.

8. RFI description.

9. Date the RFI was submitted.

10. Date USDA-ARS's response was received.

11. Identification of related Modification or Proposal Request.

F. On receipt of USDA-ARS's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Contracting Officer through the COR within seven days if Contractor disagrees with response.

1.7 UTILITY SERVICE INTERRUPTIONS

A. Coordination of Interruptions: Sufficiently in advance of each scheduled utility interruption, the Contractor shall issue a notice to all affected parties, confirming each provision of the interruption, or canceling and rescheduling. Coordinate with the Building Manager and USDA-ARS's representative, and confirm that the responsible personnel are prepared to execute the shut-down and start-up of affected existing equipment, prior to each interruption.

1.8 SUBMITTALS

A. Utility Service Interruption Plan: Within 14 calendar days from Award, Contractor shall submit a utility service interruption plan for the project. Plan shall include dates and times of each scheduled interruption, with estimated period of outage, list of existing equipment that will be affected by the interruption, proposed sequence of equipment shut-down and start-up, and responsible personnel.

1 Keep interruptions and periods of interruption to a minimum.

2 Schedule interruptions during times when the facility is unoccupied.

3. Plan must be approved in writing by the Building Manager and the USDA-ARS. If not approved, consult with the Building Manager, and revise and resubmit the plan until approved.

B. Informational Submittals

1. Subcontract List: Within 14 calendar days from Award prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

a. Name, address, and telephone number of entities performing subcontract or supplying products.

b. Number and title of related Specification Section(s) covered by subcontract.

c. Drawing number and detail references, as appropriate, covered by subcontract.

d. Coordination Drawings: Comply with the shop drawing requirements specified in Division 1 Section "Submittal Procedures".

2. Staff Names: Within 14 calendar days after Award, submit a list of principal staff assignments, including the superintendent and other primary personnel at the Project site. Identify individuals by name, duties and responsibilities, and business telephone numbers. Post copies of this list in USDA-ARS's Project Management System, in the project meeting room, temporary field office and at each temporary telephone location.

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Prior to installations, require the installer of each major component to inspect both the substrate and conditions under which work is to be performed.

1. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

2. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

B. Construction in Progress: Keep construction in progress, and adjoining materials in place, clean during handling and installation. Apply protective coverings where required for protection from damage or deterioration.

C. Completed Construction: Clean completed construction, and provide maintenance, as frequently as necessary to prevent damage or soiling or other deterioration through the remainder of the construction period. Adjust and lubricate operable components as necessary to assure operability without damage.

D. Limiting Exposures: Supervise construction operations to prevent exposure of any part of construction, completed or in progress, to harmful, dangerous, damaging or otherwise deleterious conditions during the construction period. Such conditions include but are not limited to the following:

1. Excessive static or dynamic loading.

2. Excessive internal or external pressures.

3. Excessively high or low temperatures.

4. Thermal shock.

5. Excessively high or low humidity.

6. Pollution and air contamination.

7. Water or ice.

8. Chemicals and solvents.

9. Light.

10. Radiation.

11. Puncture.

12. Abrasion.

13. Heavy traffic.

14. Soiling, staining, and corrosion.

15. Bacteria.

16. Rodent and insect infestation.

17. Combustion.

18. Electrical current.

19. High-speed operation.

20. Improper lubrication.

21. Unusual wear or other misuse.

22. Contact between incompatible materials.

23. Destructive testing.

24. Misalignment.

25. Excessive weathering.

26. Unprotected storage.

27. Improper shipping or handling.

28. Theft or vandalism.

END OF SECTION 01 31 00

SECTION 01 31 20 - CRITICAL PATH METHOD SCHEDULING

PART 1 GENERAL

1.1 SUMMARY

A. Develop a detailed Network Plan using electronic scheduling software, demonstrating complete fulfillment of all Work shown in the contract documents. Regularly update the Network Plan in accordance with the requirements of this Section, and use it in planning, coordinating, and performing all the Work under this contract. Schedule activities shall accurately depict the entire scope of work to be performed to complete the project including, but not limited to, all activities of subcontractors, consultants, equipment vendors and suppliers, USDA-ARS, and others, as required. Provide 2 week look ahead schedules.

B. The purpose of the Project Schedule shall be to:

1. Plan the project and communicate that plan.
2. Provide the status and forecast the timely completion of the work.
3. Record the actual start dates, actual finish dates and actual sequence of the work.
4. Ensure adequate planning, staffing, scheduling and reporting during execution of the Work by the Contractor;
5. Ensure coordination of the Work among all affected parties;
6. Assist the Contractor and USDA-ARS in the preparation and evaluation of the Contractor's monthly progress payments; and
7. Assist the Contractor and USDA-ARS in monitoring the progress of the work, and evaluating proposed changes to the Contract and/or requests for additional time to Project Completion.

1.2 CRITICAL PATH METHOD SCHEDULE

A. Provide a detailed, time-scaled computer generated Project Schedule with activities representing each portion of the Work for the entire Contract Performance Period. The Project Schedule shall use the Critical Path Method (CPM) for the planning, scheduling and reporting of the work to be performed under the contract. USDA-ARS shall be given the native file upon request.

B. No unspecified constraints, float suppression techniques, or use of activity durations, logic ties and/or sequences deemed unreasonable by USDA-ARS shall be used in the Project Schedule.

C. As defined by the Contract, the entire project performance period shall establish the Project Substantial Completion Date which shall be used in the planning and presentation of the Contractor's Project Schedule. USDA-ARS reserves the right not to approve any schedule deemed to have an unrealistic forecasted Substantial Completion Date. Government approval of an early completion Project Schedule shall not modify the Contractual Substantial Completion Date or Project Completion Date. The time difference between the Contractor's planned Substantial Completion Date and the Contract directed Substantial Completion Date shall be considered Project Float, jointly owned and for the mutual use of both the Contractor and USDA-ARS.

1.3 SUBMITTALS

A. Baseline Project Schedule:

1. The Contractor shall submit the Baseline Project Schedule within 21 calendar days of Award. The Baseline Schedule shall be the Contractor's detailed plan for ALL work from Award through contract completion including submittals and lead time. All punch list work shall be completed to, or prior to, the Contract Completion Date.

2. Unless otherwise approved by the USDA-ARS, the Project Schedule shall include, but is not limited to, the following items:

a. Activities necessary to depict time to prepare submittals, time for the USDA-ARS to review submittals, procurement, design, construction, third party inspections, close-out, start-up, testing and balancing, commissioning and turnover, and work by separate contractors. Refer to 01 33 00 Submittal Procedures for requirements regarding submittal review and resubmissions.

b. The schedule shall include separate activities for the submittal, review, procurement or fabrication, and delivery of key and long-lead items. The Project Schedule shall indicate submittal dates, and depict the review period as defined in the Contract or Supplementary Provisions for Contractor/A/E/USDA-ARS review. Procurement/submittal activities shall be assigned codes that will allow these activities to be sorted and printed separately from the construction/close-out/commissioning work activities.

c. Interrelationships (logic) and sequencing for ALL activities. Each activity shall have at least one successor (except for the last activity) relationship to form a logically connected Network Plan from NTP to the Contract Completion Date. Each activity shall have at least one successor with a finish relationship (finish-to-start or finish-to-finish relationship).

d. Activity durations shall be in units of whole work days. Except submittal and procurement activities, durations shall not exceed 2 weeks unless approved by the USDA-ARS. Durations for Government submittal reviews shall meet the requirements set forth in the Contract Documents. Activity durations shall not be overly short. One day durations shall not be assigned unless specifically requested by the contractor and specifically accepted by the USDA-ARS.

e. Contractual milestone events as defined in the Contract Documents including, but not limited to, phased work, work restrictions/access/shift work, and work being performed by separate contractors shall be included in the schedule. The substantial completion and project completion tasks shall be assigned to a seven (7) day work week calendar.

f. The critical path shall be annotated in the schedule through the scheduling software.

g. The following inspections shall be included as part of the schedule

1. Wall Layout/Chalk Lines

2. MEP In-Wall Inspection

3. MEP Above Ceiling Inspection

4. FA Pre-Test
5. FS Pre-Test
6. Final FA/FS Testing
7. Substantial Completion

B. Schedule Updates:

1. The Project Schedule shall be updated on a biweekly basis throughout the entire Project performance period until Project completion is achieved.

2. The Schedule Update submission shall be comprised of the following:

a. One (1) electronic copy in native format and a PDF of the entire Project Schedule shall be provided. The electronic copy shall be in a compressed format. The electronic filename shall have a unique identifier and shall include a sequential number for each update.

b. If the Contractor fails to timely submit the Schedule Update, the USDA-ARS may withhold approval of progress payments until the Contractor submits the required Project Schedule Update.

C. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

D. Modifications with a Time Impact

1. As determined by CPM schedule analysis, perform a time impact analysis during the project. Only delays beyond the control of the contractor which affects the Substantial Completion Date will be considered for a time extension.

2. When change modifications are proposed, potential delays are anticipated, or delays are experienced, the Contractor shall submit to USDA-ARS a written Time Impact Analysis describing the effect of each modification, potential delay, delay, or Contractor request on the Substantial Completion Date. This analysis shall be developed and submitted at the earliest time the Contractor becomes aware of a delay or potential delay, or as requested by the USDA-ARS. The preparation of Time Impact Analyses is considered part of the construction process and will be performed at no additional cost to the Government. The analysis shall be submitted with the 1137.

3. Failure of the Contractor to timely submit a Time Impact Analysis shall mean that it is mutually agreed that the particular modification, delay, or Contractor request does not require an extension of the contract time.

4. The Contractor shall submit a Time Impact Analysis as follows:

a. Within five (5) work days after receipt of a written change request (USDA-ARS 1137 form)

b. Within five (5) work days after receipt of a written notice by the USDA-ARS.

c. Within five (5) work days from the beginning of a delay caused by unforeseeable circumstances.

5. The Time Impact Analysis shall contain sufficient supporting documentation to enable the USDA-ARS to make a determination on the Contractor's request for time extension.

1.4 RESPONSIBILITY FOR COMPLETION

A. If, in the opinion of the USDA-ARS, the Contractor falls behind the planned progress as noted by negative float shown on the current monthly Schedule Update, the Contractor shall take any and all steps necessary to improve its progress at no additional cost to the Government. This shall not be construed as prohibiting the Contractor from increasing the number of working hours, shifts per day, working days per week, or the amount of construction equipment, or any combination of the foregoing, to eliminate the delay in the scheduled progress.

B. Failure of the Contractor to comply with the requirements of the USDA-ARS under Paragraph 1.06.A shall be grounds for determination by the USDA-ARS that the Contractor is not prosecuting the work with such diligence as will ensure completion within the contract time. Upon such determination, the USDA-ARS may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with the applicable provisions of the contract.

1.5 PERFORMANCE MONITORING

A. The USDA-ARS may elect throughout, or at any time during, the Project to record the number of workers and construction equipment working on each construction schedule activity in each area of the Project. The USDA-ARS's request for this information will be without additional cost to the Government and shall be provided within five (5) work days of receipt of the USDA-ARS's written request. This information will be used by the USDA-ARS to evaluate the adequacy of the Contractor's performance and project manpower staffing, as well as any Contractor claims.

1.6 SCHEDULER REQUIREMENTS/QUALIFICATIONS

A. Contractor's scheduler shall possess demonstrated proficiency in CPM schedule methodology and utilization of the current version of the preferred scheduling software.

B. The Contractor's project superintendent, and the scheduling representative and, to the extent applicable, the personnel responsible for developing and inputting information into the Project Schedule shall attend progress meetings throughout the duration of the Project.

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION (Not applicable)

END OF SECTION 01 31 20

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. This section includes certain schedules and reports required for documenting the progress of construction during performance of the Work.

B. Coordinate the timing for preparation and processing of schedules and reports with the performance of other construction activities, and maintain a consistent and logical correlation between updated schedules and reports.

1.2 SUBMITTALS

A. Action Submittals

1. Schedule of Inspections, Tests, and Similar Services: Prepare and submit a schedule of inspections, tests and similar services required by the Contract Documents within 10 calendar days after issuance of the Notice to Proceed. Contractor shall coordinate the schedule of inspections and tests with the Construction Schedule and other related documents. Submit electronic copies of the schedule of inspection and tests to the Contracting Officer, entities designated by the Contracting Officer, and each party involved in performance of portions of the Work where inspections, tests and similar services are required. Prepare the schedule in tabular form, including but not limited to the following information:

a. Specification section number.

b. Description.

c. Identification of applicable standards.

d. Identification of methods to be used.

e. Number of inspections, tests or similar services.

f. Time schedule or time span.

g. Responsible entity.

h. Requirements for taking samples.

i. Unique characteristics.

2. Field Correction Reports: When the need to take corrective action requires a departure from the Contract Documents, prepare a detailed report. Include a statement describing the problem and recommended changes. Indicate reasons the Contract Documents cannot be followed. Within 7 Calendar days submit a copy to the Contracting Officer or Contracting Officer's representative for approval.

B. Informational Submittals

1. Daily Construction Reports: Prepare electronic daily construction reports recording the following information concerning but not limited to events at the site. All daily reports are to be emailed to the COR at a weekly interval in a single file. Include:

a. List of subcontractors at the site.

b. List of separate contractors at the site.

c. Count of personnel at the site.

d. High and low temperatures, general weather conditions.

e. Accidents.

f. Meetings and significant decisions.

g. Unusual events (see C. Unusual Event Reports below).

h. Stoppages, delays, shortages, and losses.

i. Emergency procedures.

j. Orders and requests of governing authorities.

k. Change Orders received or implemented.

l. Services connected or disconnected.

m. Equipment or system tests and startups.

n. Partial completions or occupancies.

o. Summary of all work performed.

p. Photographs of work progress

q. USDA-ARS 139 Logs

2. Unusual Event Reports: When an event of an unusual and significant nature occurs at the site, prepare a detailed report. List the chain of events, persons participating, response by the Contractor's personnel, evaluation of the results or effects, and similar pertinent information. Submit a copy to the Contracting Officer or Contracting Officer's representative immediately. Advise the Contracting Officer or Contracting Officer's representative in advance when such events are known or predictable. Damage to government property and/or injury shall be documented in USDA-ARS Form 3620 (see safety and health section for further information)

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION (Not applicable)

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Requirements:

1. Section 0177839 "Project Record Documents" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024119 “Selective Demolition” for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos and include copy of key plan indicating each photograph's location and direction.

1.3 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by the Government.

1. Take 8 photographs to show existing conditions of the site and existing buildings exterior before starting the Work. 2 photographs shall accurately show the conditions of the Building 1 south façade; 2 additional shall show the existing historic limestone surrounding the south entry.
2. Take 8 photographs of the existing building 1 interior at all areas where the work is to be done. Accurately record physical conditions at start of construction.
3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements

C. Periodic Construction Photographs: Take 2 weekly. Select vantage points to show status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs: Take 10 photographs after date of Substantial Completion for submission as Project Record Documents. Include both exterior and Interior shots. The Government will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes certain administrative and procedural requirements for shop drawings, coordination drawings, schedules, samples and certain other quality assurance submittals.

B. Shop drawings and schedules are further categorized and defined as follows:

1. Shop drawings include drawings and schedules prepared for specific parts of the project

2. Product data includes manufacturer's standard catalogs, pamphlets and other printed materials that show and describe materials and items, and includes but is not limited to the following:

a. Product specifications.

b. Installation instructions.

c. Color charts.

d. Catalog cuts.

e. Rough-in diagrams and templates.

f. Wiring diagrams.

g. Performance curves.

h. Operational range diagrams.

i. Mill reports.

C. Samples of actual materials and items shall be provided at such scale to allow delivery for review, as well as for field samples or mock-ups of full-size physical examples erected on-site or elsewhere, to establish a true-scale standard by which the corresponding work will be judged or a standard for compliance testing.

D. Other quality assurance submittals include materials specifically prepared for the project, except drawings and schedules, and include but are not limited to the following:

1. Design data and calculations.

2. Certifications of compliance or conformance.

3. Manufacturer's instructions and field reports.

E. Approvals do not supersede requirements of the contract documents.

1.2 GENERAL SUBMITTAL REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities and with the Submittal Schedule. Unless otherwise specified, submittals shall be transmitted via USDA-ARS's electronic Project Management (USDA-ARS's Project Management System) system as PDF electronic files to USDA-ARS according to the contractor's approved construction schedule and submittal schedule. Transmit each submittal sufficiently in advance of the scheduled performance of related construction activities to avoid delaying the Work, allowing for the review times specified for submittals.

1. Coordinate each submittal with other submittals and related activities that require sequential scheduling, to allow for testing, purchase, fabrication and product delivery in a timely manner.

2. Schedule transmittal of different categories of submittals for the same element of Work and for different elements of related parts of the Work at the same time. Notwithstanding the foregoing sentence, the Contractor shall provide a complete submittal package for each Division of the specification so as to enable the Government to review the related sections together. Coordinate submittals to enable approvals and acceptances so as not to inhibit orderly progress of the Work.

3. Post electronic submittals as PDF electronic files directly to the USDA-ARS's Project Management System specifically established for the Project. USDA-ARS will return an annotated file. Annotate and retain one copy of file as an electronic project record document file.

4. Allow sufficient time for submittal review, corrections following the initial review, and re-submittal review before activities scheduled after the submittal approval.

5. Failure on the part of the Contractor to indicate approval or acceptance on submittals prior to submission to Contracting Officer will result in their being returned to the Contractor without being acted upon.

6. Any resubmission required after Government review shall be made within 10 calendar days after return of the submittal, unless specifically authorized otherwise by USDA-ARS.

7. Submittals which are determined to be incomplete or otherwise substandard will be returned to the Contractor with no further review. Delays due to incomplete or rejected submittals will not be excused.

8. Construction will not be allowed to proceed if submittals are not received in a timely manner, and will not result in an extension to the Contractor's Construction Schedule.

9. Failure by the Contractor to provide the required submittals in a timely manner may result in withheld payments until submittals are up-to-date.

10. Maintain one complete set of submittals at project site.

11. Maintain an organized submittal register at project site. This will be an agenda item for progress meetings.

12. The contractor to schedule and allow a minimum of fifteen working days for the Government's submittal review. The comment period initiates upon the receipt of the submission by the office performing the primary review. In the event the Government receives an extraordinarily lengthy or complex submittal whose review may not be able to be accomplished within the stipulated submittal review period, the contractor will be notified in writing about the extended review period within 3 working days of receipt of the submittal. Such submittals may include structural steel, curtain wall, or complex systems requiring coordination with other systems.

B. Submittal Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble each submittal item into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each submittal item.

2. Name file with submittal number or other unique identifier, including revision identifier.

   a. File name shall use Specification Section number followed by a space and then a sequential number and then the Specification Section Title (e.g., 09 29 00 01 Gyp Board). Re-submittals shall include an alphabetic suffix after another space (e.g., 09 29 00 01 A Gyp Board).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by USDA-ARS.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to USDA-ARS.

   a. Project name.

   b. Date.

   c. Name and address of Architect.

   d. Name of Contractor.

   e. USDA-ARS contract number.

   f. Name of firm or entity that prepared the submission.

   g. Names of subcontractor, manufacturer, and supplier.

   h. Category and type of submittal.

   i. Submittal purpose and description.

   j. Specification Section number and title.

k. Specification paragraph number or drawing designation and generic name for each of multiple items.

l. Drawing number and detail references, as appropriate.

m. Location(s) where product is to be installed, as appropriate.

n. Related physical samples submitted directly.

o. Indication of full or partial submission.

p. Transmittal number, numbered consecutively.
q. Contractor stamp indicating they have reviewed the submittal

r. Other necessary identification.

C. Submit originally prepared information, drawn accurately to scale. Do not reproduce Contract Documents or copy standard printed materials as the basis for Shop Drawings and Coordination Drawings.

D. Include at minimum the following information on Shop Drawings and Coordination Drawings:

1. Dimensions.

2. Identification of products and materials.

3. Compliance with specified standards.

4. Notation of coordination requirements.

5. Notation of dimensions established by field measurements.

6. Highlighted or circled deviations from the Contract Documents.

E. Sheet size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings and Coordination Drawings on sheets of at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

F. Submittals: Unless otherwise indicated, submit one electronic file (.pdf) of each drawing submission through USDA-ARS's Project Management System. The file will be marked with action taken and returned.

1.3 PRODUCT DATA

A. Collect Product Data into a single submittal for each system or element of construction. Mark each copy to show specific product choices and options applicable to the project. Product Data shall include the following information, where applicable:

1. Manufacturer's printed recommendations.

2. Compliance with recognized trade association standards.

3. Compliance with recognized testing standards.

4. Applicability of testing agency labels and seals.

5. Notation of dimensions verified for fit by field measurements.

6. Notation of coordination requirements.

B. Preliminary Submittal: Prior to submission of complete Product Data, submit a preliminary single copy of that part of Product Data when selection of options is required, such as for color charts. Preliminary submittal will be returned, with selection noted, for the Contractor's use in subsequent submittals.

C. Submittals: Unless otherwise indicated, submit one electronic copy of each Product Data submittal. One original copy will be retained and a copy will be marked with action taken and returned to the contractor.

D. Distribution: When submittal is approved or accepted, Contractor shall distribute copies for the following purposes:

1. One copy shall be marked and retained as a "Record Document."

2. Additional copies shall be provided to the manufacturers, subcontractors, suppliers, installers, governing authorities and others as required for performance of the applicable construction activities.

3. Copies required for operation and maintenance manuals

1.4 SAMPLES

A. Submit full-size, fully fabricated samples, cured and finished in the manner specified. Samples shall be physically identical to the material or product proposed for use.

B. Mount, display, or package samples to facilitate review of kind, color, pattern, texture and other qualities indicated, as a final check of these characteristics with other elements and for comparison of these characteristics with those of the actual component delivered and installed.

C. Where variation in color, pattern, texture or other characteristic is inherent in the material or product, submit at least 3 multiple units that show approximate limits of the variations.

D. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operations and similar construction characteristics.

E. Refer to other specification sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be in undamaged condition at time of use.

F. Preliminary Submittal: Where color, pattern, texture or similar characteristics are specified to be selected from a manufacturer's range of standard choices, submit a preliminary single set sample of available choices prior to submission of the complete sample. Preliminary submittal will be returned, with selection noted, for the Contractor's use in subsequent submittals.

G. Submittals: Unless otherwise indicated and except for field samples or mock-ups of full-size physical examples erected on-site or elsewhere, submit not less than 4 sets of each sample submittal. Samples may all go to different locations. One copy will be marked with action taken and returned. Comply with requirements in the individual specification section for field samples and mockups.

H. Distribution: Except for field samples or mockups, when submittal is approved, Contractor shall distribute approved copies for the following purposes:

1. One copy shall be marked and retained as a "Record Document" at the Project Site, and shall be available for comparison throughout the course of construction activity.

2. Additional copies shall be provided to manufacturers, subcontractors, suppliers, installers, governing authorities and others as required for performance of the applicable construction activities.

1.5 OTHER QUALITY CONTROL SUBMITTALS

A. Submit other quality control submittals in compliance with requirements in the individual specification sections, including Division 1.

B. Certifications: Submit notarized certifications indicating compliance with specified requirements. Certifications shall be signed by an individual authorized to sign on behalf of the Contractor.

1.6 REVIEW ACTION ON SUBMITTALS

A. For electronic submittals,

1. Submit electronic submittals via USDA-ARS's Project Management System as PDF electronic files.

a. USDA-ARS will return an annotated file. Annotate and retain one copy of file as an electronic Project record document file.

B. Compliance with specified characteristics is the Contractor's responsibility, and is not part of the Contracting Officer's review and indication of action taken.
The contract documents shall prevail in case of review action conflict.

C. Submittals without approval or acceptance shall not be used.

D. Action Stamp:

1. Each submittal will be stamped with a uniform action stamp. The stamp shall be marked to indicate one of the following actions taken:

a. For electronic submittal: Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated. For notarized signature, if required, provide paper copies for signature.

b. Final Unrestricted Release: Where marked "Approved" or "Accepted", the work covered by the submittal may proceed, provided it complies with the requirements of the Contract Documents.

c. Final But Restricted Release: Where marked "Approved " or "Accepted" "As Noted", the work covered by the submittal may proceed, provided it complies with the notations or corrections on the submittal and with the requirements of the Contract Documents.

d. Return for Re-submittal: Where marked "Not Approved" or "Not Accepted", ``Revise and Resubmit", or “Rejected”, do not proceed with the work covered by the submittal, including purchasing, fabrication, delivery or any other activity. Revise or prepare a new submittal according to the notations on the submittal or on the return transmittal. Resubmit without delay, repeating as necessary to obtain a final release action mark.

e. No Action: Where a submittal is for the record or for information or for another purpose not requiring review action, the submittal may not be returned or may be returned and marked "Action Not Required."

1.7 SUBSTITUTION REQUEST PROCEDURES

A. Substitution Requests: See section 01 25 00 - Substitution Procedures.

1.8 SUBMITTALS

A. Submittal Log – (located at end of section)

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not applicable)

END OF SECTION 01 33 00

MATERIAL APPROVAL SUBMITTAL

TO: USDA/ARS CO CC: A&E, COR	FROM: (Contractor)	PROJECT TITLE:	CONTRACT NUMBER:

(To be completed by the Contractor)			Government Use Only								
SUBMITTAL NUMBER:	PREVIOUS SUBMITTAL NUMBER (only if items listed were submitted previously):		A&E Recommendation			COR/EPM Recommendation			Contracting Officer Approval/Disapproval		
Line No.	Specification Sect. Para No., Draw No.	Description of Material (Include type, model, mfg)	APP		See Comments on Reverse	APP	DISAP	See Comments on Reverse	APP	DISAP	See Comments on Reverse
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

If an item is disapproved, a resubmittal is due within _____ calendar days of the Contracting Officer's signature below.

Contractor	A&E	COR/EPM	Contracting Officer
TYPE or PRINT NAME & TITLE	TYPE or PRINT NAME & TITLE N-A	TYPE or PRINT NAME & TITLE	TYPE or PRINT NAME & TITLE
SIGNATURE:	SIGNATURE: N-A	SIGNATURE:	SIGNATURE:
DATE:	DATE: N-A	DATE:	DATE:
By completing this form, the above signed contractor certifies that the material complies with all specifications of the subject contract.	DATE RECEIVED FROM KTR: N-A	DATE RECEIVED FROM A&E: _____	DATE RECEIVED FROM COR:

CONTRACT #:	SUBMITTAL #:

COMMENTS

Instructions: Enter the initials of the individual making the comment, the Line Number of the item for which the comment is being made, and the comment.

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

B. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

C. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, texture, or finish; as approved by Government.

D. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

E. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

F. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

G. Retain: To keep an element or detail secure and intact.

1.3 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct a conference at Project site.

1. Attendees: In addition to representatives of the Government, Architect, and Contractor, testing service representative.
2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:

    a. Fire-prevention plan.
    b. Governing regulations and Building Requirements.
    c. Areas where existing construction is to remain and the required protection.
    d. Hauling routes. Legal disposal sites.
    e. Sequence of alteration work operations.
    f. Storage, protection, and accounting for salvaged and specially fabricated items.

g. Existing conditions, staging, and limitations of areas where materials are stored.

3. Reporting: Record results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

1.4 MATERIALS OWNERSHIP

1.5 INFORMATIONAL SUBMITTALS

A. Alteration Work Program: Submit 30 days before work begins.

B. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

A. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.

B. Indicate access protection methods to maintain access to existing entrances to the existing building during construction.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
3. Building Security: methods to maintain the Government’s existing security at existing door openings to Building 1. Building security as the work progresses and while the Building 1 south façade is partially opened during demolition and prior to the new work is completed, fully securing the Building 1 facade and door openings.
4. Staff Access: Access to Building 1 shall be maintained throughout the work for the Government’s staff. Provide temporary barriers and overhead protection to assure safe and secure passage both outside and within the Building 1 work area.

C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.

2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by the Government, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

PART 2 - EXECUTION

2.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Government and all authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

2.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

C. Fire-Control Devices: Provide and maintain fire extinguishers and fire blankets. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

2.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

2.4 GENERAL ALTERATION WORK

A. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 013233 "Photographic Documentation."

B. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

C. Notify the Government of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by the Government.

END OF SECTION 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and quality-control services required by the Government and authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Government.

B. Delegated Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services. The Design Professional shall be licensed n the State of Illinois.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Government regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to the Government for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality

specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Government for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: Submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, notices, receipts for fee payments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Testing and Inspecting Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by the Government.
3. Notify the Government ten days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain the Government’s approval of mockups before starting corresponding work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by the Government’s preliminary review, to the satisfaction of the Government, before completion of final mockup.
8. Approval of mockups by the Government does not constitute approval of deviations from the Contract Documents contained in mockups unless the Government specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections are Contractor's sole responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements. Testing and any retesting shall be at the cost of the Contractor.

1. Engage a qualified testing agency to perform quality-control services.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Government and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify the Government and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to the Government.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for the Government's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - GENERAL REFERENCES

PART 1 GENERAL

1.1 DEFINITIONS

A. Agreement: The Agreement forms part of the Contract between the parties.

B. "Building Manager" is the Government employee responsible for the administration, operation and maintenance of the building.

C. Contract: see Agreement.

D. "Cutting" refers to removal of material by cutting, sawing, drilling, breaking, chipping, grinding, excavating and similar operations.

E. "Furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembling, installation and similar operations.

F. “General Terms and Conditions" are defined by the Agreement.

G. “Government" refers to the United States Department of Agriculture, Architectural Research Service (USDA-ARS).

H. "Indicated" refers to graphic representations, notes or schedules on the Drawings, or to requirements elsewhere in the Specifications or other Contract Documents. Terms such as "shown", "noted", "scheduled" and "specified" have the same meaning as "indicated" and are used to further help locate the reference, but no limitation on location is intended.

I. "Install" describes operations at the Project site, including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

J. "Installer", unless otherwise noted or under separate contract with the Government, is the Contractor or another entity engaged by the Contractor, either directly or indirectly through subcontracting, to perform a particular construction operation at the Project site, including installation, erection, application and similar operations. Installers shall be skilled in the operations they perform. Where indicated, installers shall also be Specialists as defined in the Construction Contract Clauses.

K. "Label": This must be provided by a National Recognized Testing Laboratory (NRTL), or other entity approved by USDA-ARS. The burden of documentation for validation shall be provided by the Contractor.

L. "Notice to Proceed" is the Contracting Officer's notification by letter to the Contractor to proceed with the Contract. Issuance of the Notice to Proceed may activate the time period for the completion of certain work, including Substantial Completion and Contract Completion.

M. “Owner" is the Government.

N. "Patching" refers to restoration of a surface to its original completed condition by filling, repairing, refinishing, closing and similar operations.

O. "Project site" refers to the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing other work.

P. "Provide" means to furnish and install, complete in place and ready for full use.

Q. "Punch List" is the entire listing of all incomplete and/or defective work including items that must be completed pursuant to Contract Completion.

R. “Regulations" are found in the FAR, USDA-ARSM, and CFR including orders issued by the government.

S. “Substantial Completion" is defined in the Agreement, with additional conditions in Specification Section 01 77 00 Closeout.

T. “Superintendent” refers to the Contractor’s on site representative who is responsible for continuous field supervision, coordination, planning, scheduling, and completion of the work and, unless another person is designated by the contract specification as the safety officer, jobsite safety.

U. "Testing Agency" or "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report the results of those inspections and tests.

V. Where "directed", "authorized", "selected", "approved", or a similar term is used in conjunction with the Contractor's submittals, applications, requests and other activities, and the specifications state that an individual other than the Contracting Officer, such as the Contracting Officer's Representative (COR), shall provide this action, it is understood that only the Contracting Officer has this authority unless the Contracting Officer provides written authorization to a different individual. The Contracting Officer shall provide the written authorization to the Contractor, upon request.

1. When the individual is authorized by the Contracting Officer, the Contractor may still appeal the action to the Contracting Officer.

2. The Contracting Officer's decision will be final, subject to the Disputes clause.

1.2 DRAWING SYMBOLS

A. Except as otherwise indicated, symbols used on the Drawings are those symbols recognized in the construction industry.

1. These include graphic symbols defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., as well as graphic symbols recommended by ASHRAE, ASME, ASPE, CSI, IEEE and similar technical organizations for the mechanical and electrical Drawings.

2. The Contractor shall refer uncertainty or ambiguity as to meaning of symbols to the Contracting Officer for clarification before proceeding.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: The Contract Documents require the Contractor to meet, satisfy, or otherwise follow various industry standards. Unless otherwise stated in the Contract Documents, the industry standards are incorporated into the Contract Documents as an Exhibit and Other Attachment (see Agreement, Order of Precedence) by reference and are made a part of the Exhibits and Other Attachments as if fully set forth as an Exhibit and Other Attachment.

B. Conflicting Requirements. Refer to the Agreement for the Order of Precedence clause and the latest version of USDA-ARS's P100 Facilities Standards.

C. Publication Date. The publication date for any industry standard is the most recent version as of the date that the Government issues the Solicitation. When an applicable industry standard has been revised after contract award that may result in an increase in cost or time , the Contractor shall submit a change order proposal for the Government's consideration.

D. Specialized Work. In certain instances, a Specification section may require that the Contractor engage a specialized company or individual to perform certain work. In such instances, the Contractor shall subcontract for such work. The Contractor may not perform any such work with its own, in-house employees.

E. Abbreviations and Acronyms used in the Specifications and other Contract Documents mean the recognized name of a trade association, standards-producing organization, and authority having jurisdiction or other entity applicable to the context of the particular provision. Except as otherwise indicated, refer to the current editions of the following publications for abbreviations:

1. "Encyclopedia of Associations: National Organizations of the U.S.", published by Gale Research.

2. "National Trade and Professional Associations of the United States", published by Columbia Books.

3. "Means Illustrated Construction Dictionary - New Unabridged Edition" published by R.S. Means Company, Inc.

4. "Abbreviations and Acronyms," paragraphs A. through E. identified herein.

F. Abbreviation and Acronyms Listing. The following names are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council

2. AAMA - American Architectural Manufacturers Association
3. ACIL - American Council of Independent Laboratories
4. ADC - Air Diffusion Council
5. AGC - Association of General Contractors
6. AIA - The American Institute of Architects
7. AIHA - American Industrial Hygiene Association
8. ALI - American Lighting Institute
9. ALSC - American Lumber Standards Committee
10. AMCA - Air Movement and Control Association International, Inc.
11. ANSI - American National Standards Institute
12. APA - American Plywood Association (see EWA)
13. ARI - Air-Conditioning and Refrigeration Institute
14. ASA - Acoustical Society of America
15. ASC - Adhesive and Sealant Council
16. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
17. ASME - American Society of Mechanical Engineers
18. ASTM - American Society for Testing and Materials
19. AWS - American Welding Society
20. BAS - Building Automation System
21. BHMA - Builders Hardware Manufacturers Association
22. BIM - Building Information Model
23. BOD - Basis of Design
24. CABO - Council of American Building Officials
25. CC - Construction Contractor
26. CE - Construction or Consulting Engineer
27. CEx - Contract Executive

28. CFR - Code of Federal Regulations (Publications available from the Government Printing Office)

29. CO - Contracting Officer

30. COTR - Contracting Officer's Technical Representative

31. COBIE - Construction to Operations Building Information Exchange

32. CPSC - Consumer Product Safety Commission

33. CS - Commercial Standard (U.S. Department of Commerce)

34. CSI - Construction Specifications Institute

35. DHI - Door and Hardware Institute

36. DP - Design Professional

37. EIA - Electronic Industries Association

38. EPA - Environmental Protection Agency

39. EPAct 2005 – Energy Policy Act of 2005

40. FCC - Federal Communications Commission

41. FCICA - Floor Covering Installation Contractors Association

42. FM - Factory Mutual System

43. FPE - Fire Protection Engineer

44. FS - Federal Specification (Publications available from USDA-ARS)

45. GA - Gypsum Association

46. GANA - Glass Association of North America

47. USDA-ARS - General Services Administration

48. HEI - Heat Exchange Institute

49. HFES - Human Factors and Ergonomics Society

50. HI - Hydraulic Institute

51. HI - Hydronics Institute - Division of Gas Appliance Manufacturers Association

52. IAS - International Approval Services - Division of Canadian Standards Association

53. ICEA - Insulated Cable Engineers Association

54. IEC - International Electrotechnical Commission (Publications available from ANSI)

55. IES - Illuminating Engineering Society

56. IEEE - Institute of Electrical and Electronics Engineers

57. IESNA - Illuminating Engineering Society of North America

58. INCE - Institute of Noise Control Engineering

59. ISC - Interagency Security Committee

60. LEED - Leadership in Energy and Environmental Design

61. LGSI - Light Gage Structural Institute

62. MCAA - Mechanical Contractors Association of America

63. MFMA - Metal Framing Manufacturers Association

64. NAIMA - North American Insulation Manufacturers Association

65. NAMI - National Accreditation & Management Institute, Inc.

66. NBHA - National Builders Hardware Association (See DHI)

67. NBS – National Bureau of Standards

68. NIBS - National Institute of Building Sciences

69. NIST - National Institute of Standards and Technology

70. NEBB - Natural Environmental Balancing Bureau

71. NEC - National Electrical Code

72. NECA - National Electrical Contractors Association

73. NEI - National Elevator Industry

74. NEMA - National Electrical Manufacturers Association

75. NFPA - National Fire Protection Association

76. NIA - National Insulation Association

77. NIAC - National Insulation and Abatement Contractors Association (See NIA)

78. NIST - National Institute of Standards and Technology (U.S. Department of Commerce)

79. NPCA - National Paint and Coatings Association

80. NRMCA - National Ready Mixed Concrete Association

81. NRTL - Nationally Recognized Testing Laboratory

82. NVLAP - National Voluntary Laboratory Accreditation Program (via NIST)

83. NWMA - National Woodwork Manufacturers Association (See NWWDA)

84. O & M - Operations & Maintenance

85. OSHA - Occupational Safety and Health Administration (U.S. Department of Labor)

86. P100 - USDA-ARS Facilities Standards for the Public Building Service (PBS)

87. PCA - Portland Cement Association

88. PDCA - Painting and Decorating Contractors of America

89. PMO – USDA-ARS PBS Program or Project Management Office?

90. PPFA - Plastic Pipe and Fittings Association

91. PPI - Plastics Pipe Institute (The Society of the Plastics Industry, Inc.)

92. PS Product Standards of the National Bureau of Standards (U.S. Department of Commerce)

93. QAQC - Quality Assurance Quality Control

94. RFCI - Resilient Floor Covering Institute

95. RFP - Request For Proposal

96. SDI - Steel Door Institute

97. SFPE - Senior Fire Protection Engineer

98. SGCC - Safety Glazing Certification Council

99. SHLMA - Southern Hardwood Lumber Manufacturers Association (See HMA)

100. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association

101. SPI - The Society of the Plastics Industry, Inc.

102. SPIB - Southern Pine Inspection Bureau

103. SSPC - Steel Structures Painting Council - The Society for Protective Coatings

104. TAB - Testing, Adjusting, and Balancing Bureau

105. TIMA - Thermal Insulation Manufacturers Association (See NAIMA)

106. UL - Underwriters Laboratories Inc.

107. VOC – Volatile Organic Compound

108. WASTEC - Waste Equipment Technology Association

109. WEF - Water Environment Federation

110. WPCF - Water Pollution Control Federation (See WEF)

111. WRI - Wire Reinforcement Institute

112. WSC - Water Systems Council

113. WSFI - Wood and Synthetic Flooring Institute (See MFMA)

114. WWPA - Western Wood Products Association

115. W.W.P.A. - Woven Wire Products Association

PART 2 PRODUCTS (Not applicable)

PART 3 EXECUTION (Not applicable)

END OF SECTION 01 42 00

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.
   a. Headhouse insulated exterior masonry and high-density fiber cement rainscreen system.
   b. Greenhouse exterior glass and aluminum glazing system on steel superstructure

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Government, Construction Manager, Architect, , and installers of major systems whose Work is included in integrated exterior mockups.
2. Review locations and extent of mockups.
3. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Indicate the integrated exterior mockups.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For integrated exterior mockups.

1.6 QUALITY ASSURANCE

A. Refer to the requirements in Section 014000 "Quality Requirements."

B. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.

4. Demonstrate acceptable coordination between components and systems.

C. Fabrication: Build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by the government.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

D. Notifications:

1. Notify Government and Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow five days for initial review and each re-review of each mockup.

E. Approval: Obtain the Government's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, mockups approved by the Government may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups according to approved Shop Drawings and as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Construct foundation and superstructure to support integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by the Government Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:
   1. Masonry back-up.
   2. Air and weather barriers.
   3. Thermal insulation.
   4. Through-wall base flashing.
   5. Flashing and sheet metal trim.
   6. Joint sealants.
   7. Fiber cement wall panels.
   8. Glazed greenhouse exterior metal walls/sloped glazing.

F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.

G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work. Obtain the Government's approval for modifications.

H. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and installations, including connections.

   1. Exterior wall panel system as specified in Section 07 42 46, High Density Cementitious Wall Panels.

   2. Greenhouse exterior glazing as specified in Section 13 34 13.13, Glazed Structures – Greenhouses

B. Integrated exterior mockups will be considered defective if they do not pass tests and inspections.

C. Prepare mock-up inspection reports.

END OF SECTION 01 43 39

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes requirements for temporary utilities, support facilities and protection.

1. Temporary utilities include but are not limited to the following:

a. Temporary electric power and lighting.

b. Temporary heat and ventilation.

2. Support facilities include but are not limited to the following:

a. Field offices, storage sheds and fabrication shops.

b. Waste disposal services.

c. Other construction aids and miscellaneous services and facilities.

3. Protection includes but is not limited to the following:

a. Temporary fire protection.

b. Barricades, warning signs, and lights.

c. Enclosure fence.

d. Environmental protection.

e. Enclosure partitions.

B. Provide temporary facilities and controls required for construction activities except, for facilities and controls indicated as existing or provided by the Government or others.

1.2 UTILITY USE CHARGES

A. Unless otherwise specified, the Contractor shall pay utility service use charges for temporary utilities used by all entities engaged in construction activities at the Project site. Costs for these services are included in the Contract price.

B. Sewer Service: Contractor may use the Government's existing sewer system, without payment of use charges.

C. Electric Power Service: Contractor may use electric power from the Government's existing electric power system, without metering and without payment of use charges.

1.3 QUALITY ASSURANCE

A. Standards and Regulations: In temporary facilities, comply with industry standards, applicable laws, and regulations of authorities having jurisdiction, including but not limited to the following:

1. Health and Safety regulations.

2. Police, fire department, local fire marshal and rescue squad rules.

3. Environmental protection regulations.

4. For temporary egress, ABAAS regulations.

5. NFPA 241 "Standards for Safeguarding Construction, Alterations and Demolition Operations".

6. ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

7. NECA Electrical Design Library "Temporary Electrical Facilities", NFPA 70, and NEMA, NECA and UL standards and regulations for temporary electric service.

B. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Install, operate, maintain and protect temporary facilities and controls.

1. Keep temporary facilities clean and neat in appearance.

2. Operate temporary facilities in a safe and efficient manner.

3. Relocate temporary facilities if needed as Work progresses.

4. Do not overload temporary services and facilities or permit them to interfere with progress.

5. Provide fire prevention.

6. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to be on-site.

B. At the earliest possible time, when acceptable to USDA-ARS, change over from temporary services to use of permanent services and remove temporary facilities when no longer needed.

C. Temporary Use of Permanent Facilities and Services: Contractor shall assume responsibility for the operation, maintenance and protection of the facility and each permanent service during its use as a construction facility prior to the Government's acceptance.

D. Existing Equipment and Items: Cover or otherwise protect and provide security for existing equipment and other items that are to remain in place, to prevent soiling, damage and loss, the cost of which is the responsibility of the Contractor.

1. Temporarily move equipment and other items that interfere with the performance of required work.

2. Store equipment and other items that have been temporarily removed. Upon reinstallation, clean and, if damaged, repair or replace equipment and items to match their condition prior to removal.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide undamaged materials in serviceable conditions and suitable for use intended.

B. Tarpaulins: Waterproof, fire-resistant UL labeled with flame spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene fire-retardant tarpaulins.

C. Wood: Lumber complying with DOC PS 20 and applicable grading rules of an inspection agency certified by ALSC's Board of Review for specific use. Provide preservative treated lumber where partially or fully in contact with the earth, concrete or masonry. Provide fire retardant treated lumber for temporary purposes where fire rated products are normally required.

D. Dust control:

1. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 914 by 1624 mm (36 by 60 inches).

2. Polyethylene Sheet: Reinforced, fire-resistive sheet, 0.25 mm (10 mils) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test 2.

E. Temporary Lighting systems shall be solid state (e.g., LEDs) (specify minimum foot candles and OSHA requirements).

2.2 EQUIPMENT

A. Provide equipment in serviceable condition and suitable for use intended.

1. Light Fixtures: General service luminaires with required lumen output for adequate illumination.

a. Provide guard cages or tempered glass enclosures where exposed to breakage.

b. Provide exterior fixtures when exposed to moisture.

PART 3 EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities.

B. Locate facilities where they will serve the project with minimum interference to performance of construction activities. Maintain, relocate and modify facilities as required for the duration of the performance of the Work.

3.2 TEMPORARY UTILITIES

A. Engage the appropriate local utility companies to install temporary services or connect to existing services. Where a utility company provides only part of a service, provide the remainder with matching and compatible materials and equipment in compliance with utility company recommendations. Coordinate interruptions and outages with USDA-ARS Building Manager and any affected stakeholders, provide adequate utility capacities, and obtain easements if necessary. At Substantial Completion, restore these facilities to conditions existing before initial use.

1. Lighting: Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide lighting that provides adequate illumination for construction operations and traffic conditions.

B. Existing Elevator Use: Use of USDA-ARS's existing freight or passenger elevators will not be permitted unless approved by the USDA-ARS Building Manager. If allowed, elevators must be protected, cleaned and maintained in a condition acceptable to USDA-ARS. At Substantial Completion, restore elevators to conditions existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.

2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator cars and entrance doors and frames. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish the entire unit, or provide new units as required.

C. Collection and Disposal of Waste/Salvaged Material: Collect waste from construction areas and elsewhere daily. Collect salvaged/recycled material from construction areas and elsewhere as necessary. Enforce requirements strictly and dispose of material lawfully.

1. Comply with NFPA 241 for removal of combustible waste material and debris.

2. Do not hold waste materials more than 7 days during periods when the ambient temperature remains continuously less than 80°F (27°C), or more than 3 days when the temperature exceeds or is expected to rise above 80° (27°C).

3. Handle and properly containerize hazardous, dangerous or unsanitary waste materials separately from other waste.

4. Comply with Construction non hazardous Waste Management and Disposal

3.3 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential uses to minimize waste and abuse.

B. Termination and Removal: Unless USDA-ARS requests that a temporary facility be maintained longer, each temporary facility shall be removed not later than at Substantial Completion when the need for its service has ended and can be replaced by use of a permanent facility. Complete, restore , and replace permanent construction that may have been delayed and damaged because of interference with the temporary facility.

1. Materials and facilities that constitute temporary facilities are the property of the Contractor, except the Government reserves the right to take possession of project identification signs.

2. Prior to project completion, replace, clean, and restore permanent facilities used during the construction period including, but not limited to, the following:

a. Replace air filters and clean the inside of ductwork and housings.

b. Replace luminaries burned out or noticeably dimmed by hours of use.

c. Comply with 01 77 00 Closeout procedures.

END OF SECTION 01 50 00

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

A. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction.

B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line.

1.3 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones.

1.4 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.5 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Excavation or other digging unless otherwise indicated.
6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:

1. As indicated in the drawings or at a minimum: Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches (2400 mm) apart. Fencing is available in high-visibility orange color.

   a. Height: 48 inches (1200 mm)

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 2-inch (50-mm) uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches (150 mm) of tree trunks.
2. Install temporary root protection matting over mulch to the extent indicated.

B. Trunk Protection: Protect the trunk of each tree to remain as may be required.

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected areas except by entrance gates.
1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to the Government
2. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

3.5 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
2. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

END OF SECTION 01 56 39

SECTION 01 57 23 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.2 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPP): Within 15 days of date established for commencement of the Work, submit completed SWPPP.

1.5 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 01 57 23

SECTION 01 59 50 - SAFETY AND HEALTH

PART 1 GENERAL

1.1 SUMMARY

A. This project includes or may be expected to include the following tasks that involve unique safety and health risks.

1. Asbestos abatement or working around asbestos
2. Lead abatement or working around surface coatings or dust that contain lead
3. Work generating silica dust (e.g. concrete drilling, jack-hammering, etc.)
4. The use of powered equipment
5. The use of scaffolds
6. Electrical work
7. Work in confined spaces
8. Work involving high noise levels
9. Work requiring lock-out/tag-out (i.e. controlling hazardous energy)

B. References: In addition to publications referenced in the Construction Contract Clauses, the following Code of Federal Regulations (CFR) and publications apply to the conduct of the work. State and local safety and health regulations that apply are not cited herein. Current editions at the date of the agreement apply. The more stringent requirements shall apply.

1. 29 CFR Part 1910 Occupational Safety and Health Administration (OSHA) Occupational Safety and Health Standards for General Industry.
2. 29 CFR Part 1926 OSHA "Safety and Health Regulations for Construction"
3. 40 CFR 260 - 279 EPA Resource Conservation and Recovery Act (RCRA)
4. National Fire Protection Association (NFPA) 70E Electrical Safety Requirements for Workplace Safety
5. National Fire Protection Association (NFPA) 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations
6. USDA-ARS Public Buildings Service Asbestos Management policy
7. USDA-ARS PBS Fuel Storage Tank Management policy

8. USDA-ARS PBS Indoor Air Quality Management policy (1000.8)

9. USDA-ARS PBS Safety and Health Management policy (5940.3)

10. USDA-ARS PBS P-100 Facilities Standards for the Public Buildings Service

11. ANSI/IICRC S500: Professional Water Damage Restoration

12. ANSI/IICRC S520: Professional Mold Remediation

13. EPA 402-K-01-001: Mold Remediation in Schools and Commercial Facilities

14. Applicable Federal, State, and local safety & health regulations.

C. Acquisition of Publications:

1. Codes of Federal Regulations (CFR) may be obtained online (https://www.govinfo.gov/app/collection/cfr).

2. NFPA publications may be purchased from the National Fire Protection Association (https://www.nfpa.org/).

3. ANSI publications may be purchased online from the ANSI Webstore (https://ansi.org/).

1.2 SUBMITTALS

A. The Contractor shall submit a Site-specific Construction Safety and Health Plan (CSHP) to USDA-ARS, at least 7 days prior to the pre-construction meeting. The CSHP shall be accepted by USDA-ARS prior to the issuance of the Notice to Proceed.

Site-specific CSHP as defined below:

The Site-specific CSHP is a written document that describes the process for identifying the physical and health hazards that could harm workers, procedures to reduce these hazards and prevent accidents, and steps to take when accidents occur. The written CSHP is the Contractor's blueprint for keeping their workers, our employees, tenants, and the public safe.

The CSHP shall be a site-specific document, not a generic shelf plan, that is adapted to the specific safety and contractual needs of the project. The larger and more complex the project, the larger and more complex the safety plan. Every task in a project should be reviewed to identify known hazards and shall provide general guidance for those hazards that are unexpected or unpredictable and how those will be mitigated. These shall be in the form of a job hazard analysis and shall include job steps, potential occupational hazards, and the action/procedure to control, minimize or eliminate the potential hazards and risks, as well as any additional information that serves to increase the safety and health of workers performing the specific job. Plans shall address the following conditions or hazards and are not limited to:

1. The Contractor shall include the project name, the project description, the project location, and which safety features of the safety and health plan will apply to this project based on scope.

2. The Contractor shall designate a site safety and health officer (SSHO), who is responsible for and has the authority to ensure this plan is adhered to throughout the project, along with applicable safety & health regulations and this specification section. The SSHO shall have a minimum of a valid OSHA 30-hour Construction Safety card received within the last five years. The designated SSHO will be listed in the safety and health plan, along with a contact number. SSHO shall be full-time for the duration of the project.

3. The Contractor shall also establish and list in the safety and health plan any required competent person and/or designated person when required by OSHA regulations for fall protection, demolition, lock-out/tag-out, ladders, and scaffolds, as well as the following work:

   a. Asbestos competent person

   b. Silica work exposure plan competent person

   c. Lead competent person

   d. Energized electrical qualified workers

   e. Lead-paint competent person

   f. The CSHP shall include those controls and accident prevention procedures to address each of the following as required based on the site-specific scope of the project:
   Overall electrical safety-related work practices

   g. Control of Hazardous Energy (Lockout / Tag-out procedures)

   h. Personal Protective Equipment (hard hats, shoes, glasses, earplugs, respirators, etc.)

   i. Safeguarding of powered tools and equipment

   j. Equipment Guarding

   k. Dust and odor control

   l. Asbestos abatement controls

   m. Lead-paint abatement controls

   n. Silica Work Exposure plans

   o. Emergency and first-aid procedures

   p. Hazardous waste cleanup and disposal safeguards

   q. Occupational Noise Exposure

   r. Hot Work permitting procedure (e.g., welding, brazing, etc.)

NOTE: The above are safety and health issues commonly encountered during construction work but are not a comprehensive list of all potential project risks.

4. The plan shall include the Contractor's reporting procedures in the event of an accident and a call-down tree containing contact information for all project staff.

5. The Contractor shall provide to the Contracting Officer or their representative USDA-ARS, local, city, and/or state permits for the following as applicable: asbestos abatement, lead abatement, PCB abatement, hazardous waste cleanup, and disposal.

6. The Contractor shall provide the CO and the USDA-ARS property manager's office with a list of chemical products and/or hazardous materials expected to be used on the project site. The list shall include the Safety Data Sheets (SDS) for each product and shall be a part of the Contractor's Hazard Communication Plan (HCP). The Contractor shall review and update the product list at a regular interval for the duration of the project.

   The Contractor's Hazard Communication Plan (HCP) with the accompanying Chemical product list and/or hazardous materials shall be submitted to USDA-ARS with the CHSP.

   The HCP shall describe the proper use, quantities, location, safety, SDS, storage, security, and access of all chemical products and/or hazardous chemicals. The HCP shall be accessible to all subcontractors and other 3rd parties on the project site.

   The Hazard Communication Plan shall clearly and concisely describe the methods used to provide all on-site personnel access to their on-site SDSs, and how they will inform the other employer(s) of any precautionary measures that they need to consider.

1.3 SAFETY MEETING

A. Pre-Construction Meeting: The General Contractor and Subcontractors shall meet with the USDA-ARS CO, COR, PM, and other USDA-ARS representatives as appropriate after the Contract Award and before the issuance of the Notice to Proceed. The meeting shall cover:

   1. The Contractors' site-specific CSHP, SDS list, HCP and other related Health and Safety information.

   2. Specific safety and health features for the project are intended to protect the safety of employees, Government representatives, and others while on-site throughout the project.

   3. The Contractors shall resolve any questions or concerns raised in a manner satisfactory to the USDA-ARS representatives.

B. Ongoing Meeting: The general contractor and subcontractors shall conduct regular safety meetings with the USDA-ARS project manager and other USDA-ARS representatives. Weekly meetings throughout the duration are typical for most projects. The Contractor shall review and update the CSHP, SDS list, HCP and other related Health and Safety information and distribute to project stakeholders on an on-going basis. The Contractor shall submit revisions to USDA-ARS for review prior to distribution.

C. The Contractor shall prepare meeting minutes for each meeting and upload them into PMIS. The Contractor's project manager, safety officer, project superintendent, and any other supervisors shall be required to attend these meetings with the Government and its designated on-site representatives.

1.4 SAFETY AND HEALTH PROGRAM

A. Contractor Responsibility: The Contractor shall assume full responsibility and liability for compliance with applicable codes, standards and regulations about the health and safety of personnel during execution of the Work and shall hold the Government harmless for any action on the Contractor's part, or that of the Contractor's employees or Subcontractors, that results in illness, injury or death.

B. Site Safety and Health Officer: A trained and experienced individual shall be delegated in writing as the Site Safety and Health Officer (SSHO). The SSHO shall have a minimum of a valid OSHA 30-hour Construction Safety card received within the last five years. Projects over $10 million require a full-time on-site SSHO. The SSHO shall be responsible for the development, implementation, oversight, and enforcement of the Contractor's Accident Prevention Plan (APP) on-site, which shall address all activities for which the Contractor is responsible. The Contractor may appoint as many individuals as he or she deems appropriate to accomplish the provisions of this section. The SSHO shall typically remain on-site full-time during activities conducted under this contract. The SSHO may be an individual with other responsibilities, already identified to be on-site and who has the authority and appropriate knowledge to oversee and act on the provisions of this section.

C. The Contractor shall provide for site visitors Personal Protective Equipment (PPE) per OSHA for use during their visits. Provide a minimum of 10 sets with replacements for items not suitable for reuse.

PART 2 PRODUCTS

2.1 PROTECTIVE EQUIPMENT

A. Special facilities, devices, equipment, and similar items used by the Contractor in the execution of the Work shall comply with the applicable regulations.

PART 3 EXECUTION

The Contractor shall assume full responsibility and liability for compliance with applicable codes, standards and regulations pertaining to the health and safety of personnel during the execution of the project and shall hold the Government harmless for any action on the Contractor's part, or that of the Contractor's employees or Subcontractors, that results in illness, injury or death. The Contractor is also responsible for the safety of USDA-ARS staff, FOB employees, regulators, Federal agency officials, and any other visitors while present on the construction site.

3.1 HAZARDOUS MATERIALS AND CONDITIONS

A. The Contractor shall advise USDA-ARS of any hazardous material and/or hazardous conditions encountered during the execution of the work. USDA-ARS shall determine if the Contractor must perform additional tests and if the work for the particular material or condition shall cease, at the direction of the Contracting Officer. Work shall recommence at the direction of USDA-ARS. The SSHO shall take measures to protect all personnel on-site until USDA-ARS has rendered its decision.

3.2 EMERGENCY SUSPENSION OF WORK

A. If any employees of the Contractor or Subcontractor observe any unsafe act or hazard which could jeopardize their personal safety or the safety of others, that employee must take steps to resolve the issue, including notifying the supervisor/foreman of the hazard. The supervisor/foreman has the ability to ensure the hazardous condition is corrected, prevent exposure to the hazard, and/or stop the work until that hazardous condition is corrected. Unsafe acts and or hazards that cannot be immediately corrected in these manners will be brought to the attention of the USDA-ARS project manager and USDA-ARS project contracting officer.

B. When the Contractor is notified by USDA-ARS of non-compliance with the safety or health provisions of the contract, the Contractor shall immediately cease work in the subject area unless otherwise instructed by the Contracting Officer or their representative and correct the unsafe or unhealthy condition.

1. If the Contractor fails to comply promptly, all or part of the work will be stopped by notice from the USDA-ARS contracting officer or their representative.

2. When USDA-ARS determines that satisfactory corrective action has been taken by the Contractor, work shall resume.

3. The Contractor shall not be allowed any extension of time or compensation for damages in connection with a work stoppage for an unsafe or unhealthy condition.

3.3 PROTECTION OF PERSONNEL

A. The Contractor shall take necessary precautions to prevent injury to the public, occupants, and project staff on the site or in close proximity to be affected by the project. The public and occupants include all persons not employed by the Contractor or a Subcontractor.

B. The work area shall be isolated from unauthorized entry through the use of signage, barrier tape, fences, barricades, or similar means. Control by authorized personnel shall be done where passage through is necessary for the work.

1. Provide traffic barricades and traffic control signage where construction activities occur in vehicular areas.

2. Corridors, aisles, stairways, doors, and exit ways shall not be obstructed or used in a manner to encroach upon routes of ingress or egress utilized by the public or occupants or to present an unsafe or unhealthy condition to the public or occupants.

3. Store, position, and use equipment, tools, and materials, in a manner that does not present a hazard to the public or occupants.

4. Store and transport refuse and debris in a manner to prevent unsafe and unhealthy conditions for the public and occupants. Cover refuse containers and remove refuse on a frequent regular basis acceptable to USDA-ARS. Use tarpaulins or other means to prevent loose transported materials from dropping from trucks.

3.4 EMERGENCIES AND FIRST AID

A. The Contractor shall provide for use on-site: emergency first aid equipment, an ABC-Rated Fire Extinguishers per NFPA 10 and NFPA 241, and absorbent material of sufficient quantity to collect any spill which might occur. The Contractor shall also maintain and post on-site a list of emergency phone numbers and points of contact for fire, hospital, police, and ambulance. All corrosive chemicals used that require a 15-minute eye flush as listed in the first aid section of the Safety Data Sheet require the contractor to bring a portable ANSI/ISEA Z358.1 rated eyewash on site if one is not available.

B. The Contractor shall submit an electronic copy of each accident report to the USDA-ARS project manager that the Contractor or Subcontractors submits to their insurance carriers, within seven calendar days after the date of the accident. Any accident or occupational illness that requires reporting to OSHA must be reported to USDA-ARS within 48 hours following the incident. The Contractor will complete the USDA-ARS Form 3620 (include a copy of this form as part of the submittal). In addition, if the Contractor causes any damage to USDA-ARS property this information must also be recorded on the 3620. The Contractor is responsible for reporting to OSHA all recordable injuries or illnesses of their employees within all required timeframes and methods, including those that result in hospitalization, amputation, death, or loss of an eye.

3.5 ENVIRONMENTAL PROTECTION

A. In addition to the unique provisions required for environmental remediation work (asbestos, lead-based paint, PCBs, hazardous waste), the Contractor shall dispose of any other contaminant waste per EPA, state, and local requirements.

B. The Contractor shall comply with applicable laws and ordinances regarding noise control, including but not limited to 29 CFR 1910.95 and 29 CFR 1926.52.

3.6 WATER INTRUSION AND MOLD REMEDIATION

A. Should any project-related incident result in water damage to building materials, it shall be the Contractor's responsibility to bring such information to the attention of the Contracting Officer, both verbally and in writing, as quickly as possible for resolution.

B. The Contractor shall immediately respond using a professional company that is trained in water remediation that has the knowledge, equipment, and resources to employ industry-related standard practices following ANSI/IICRC S500 Professional Water Damage Restoration & S520 Professional Mold Remediation along with EPA Mold Remediation in Schools and Commercial Facilities.

C. After each event, a separate visual inspection and non-invasive assessment of the space must take place and the results provided to the Contracting Officer along with a detailed action plan to address the issues within 24 hours of the incident.

D. Mold remediation that is required as a result of the Contractor not fully addressing the situation promptly will be the financial responsibility of the Contractor. Remediation shall be completed by a qualified mold remediation contractor using industry-standard practices following ANSI/IICRC S500 Professional Water Damage Restoration & S520 Professional Mold Remediation along with EPA Mold Remediation in Schools and Commercial Facilities. This work is required to be monitored and clearance provided by an independent third-party consultant at no cost to the government.

END OF SECTION 01 59 50

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project, including manufacturers' standard warranties on products and special warranties.

B. The following definitions are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms that are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" means items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and other terms of similar intent.

2. "Materials" means products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. "Equipment" means products with operational parts, whether motorized or manually operated, and products that require service connections, such as wiring or piping.

C. See 01 25 00 - Substitution Procedures for requests for substitutions:

D. Warranties: Standard, and special warranties required by the individual sections of the Specifications shall provide guarantees in terms of time limits or rights of the Government in addition to those contained in the Construction Contract Clauses.

1. Standard product warranties shall be preprinted written warranties published by individual manufacturers for particular products, and shall be specifically endorsed to the Government by the manufacturer.

2. Special warranties shall be specifically written to incorporate particular requirements of the Contract Documents, and shall be endorsed to the Government by the entities responsible for the work, as stated in the individual section.

1.2 SUBMITTALS

A. Submittals: See 01 33 00 - Submittal procedures

B. Substitutions: See 01 25 00 - Substitution Procedures

C. Submit written warranties to the Government prior to the date for Project Completion, unless an earlier time of submission is specified elsewhere in the Contract Documents or requested by the Government. When a designated portion of the Work is completed and occupied or used by the Government, by a separate agreement with the Contractor during the construction period, submit properly executed warranties within 15 days after completion of that designated portion of the Work. Identify and clearly label on the product the effective start time and end time for each warranty.

1. When the Contract Documents require the Contractor to execute a special warranty, provide a written document that contains the appropriate terms and identification, executed by the required parties.

2. See technical Specification divisions for other warranty language.

1.3 QUALITY CONTROL

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source. Equipment of the same function shall be manufactured by the same entity, unless otherwise indicated.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected.

C. Labels and nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous. Labels indicating compliance with recognized organizations require confirmation by submitted documents.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information:

a. Name of product manufacturer.

b. Model and serial numbers.

c. Operating data such as capacity, speed and ratings.

d. Name and phone number of Installer.

3. Protection: Labels and nameplates shall be protected from defacement and other damage during the remainder of the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule product delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to provide minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

3. Deliver products to the site in an undamaged condition, in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Coordinate inspection with Government, USDA-ARS COR or designated representative (i.e Bldg. Manager, CM, etc.).

5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, undercover in a weather-tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within the range required by the manufacturer's instructions.

PART 2 PRODUCTS

2.1 PRODUCT COMPLIANCE AND REQUIREMENTS

A. Provide products complete with accessories, trim, finish, safety guards, devices and other items needed for a complete installation and the intended use and effect. Where specified and available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents, including the Construction Contract Clauses, govern product selection. Requirements for product selection include the following:

1. Where the Specifications lists manufacturers' names or product designations, the Contractor may provide any product that complies with the requirements, subject to the following conditions:

a. Available Manufacturers: Where a Specification paragraph or subparagraph titled "Available Manufacturers" lists a minimum of three manufacturers' names, provide a compliant product by one of the manufacturers named or by another manufacturer.

b. Available Products: Where a Specification paragraph or subparagraph titled "Available Products" lists a minimum of three product designations, providing one of the products designated or another compliant product.

c. Basis of Design: Where a Specification paragraph or subparagraph titled "Basis of Design" includes a product designation, provides the product designated, or requests a Substitution of a compliant product by a named or other manufacturer.

2. Descriptive Requirements: Where Specifications describe a product or assembly, listing the characteristics required, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

3. Performance Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.

4. Prescriptive Requirements: Where Specifications require products that are produced using specific ingredients and components, including specific requirements for mixing, fabricating, curing, finishing, testing and similar operations in the manufacturing process, provide products produced in accordance with the prescriptive requirements that otherwise comply with Contract requirements.

5. Codes, Standards and Regulations: Where Specifications require compliance with an imposed code, standard or regulation, select a product that complies with these requirements.

6. Visual Matching: Where Specifications require matching an established Sample, the Government's decision will be final on whether a proposed product matches satisfactorily. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions concerning "substitutions" for selections of a matching product in another product category.

7. Visual Selection: Where specified product requirements include the phrase "as selected from manufacturer's standard colors, patterns, textures" or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Government will select the color, pattern and texture from the manufacturer's product line.

C. The Contractor's submittal and the Government's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

2.2 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work.

D. Rejection of Warranties: The Government reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment for the Work or part of the Work,, the Government reserves the right to refuse to accept the Work until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01 60 00

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes certain general procedural requirements governing the Contractor's execution of the Work, including, but not limited to laying out the work, general installation of products, correction of defective work, and cleaning.

B. Substitution: Changes in methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract shall comply with the procedures and conditions specified for Substitutions in the Construction Contract Clauses and 01 60 00 - Product Requirements.

1.2 QUALITY CONTROL

A. Workmanship Standards: Initiate and maintain procedures to ensure personnel performing the work are skilled and knowledgeable in the methods and craftsmanship needed to produce the required levels of workmanship. Remove and replace work that does not comply with workmanship specified and standards recognized in the construction industry for the applications indicated. Remove and replace work damaged or deteriorated by faulty workmanship or replacement of other work.

1. Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable installation instructions and recommendations to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.

2. Specialists: Where the individual sections of the specifications require specialists to perform the work, comply with the requirements specified in the Construction Contract Clauses. The assignment of a specialist shall not relieve the Contractor from complying with applicable regulations, union jurisdictional settlements or similar conventions, and the final responsibility for fulfillment of the entire requirements remains with the Contractor.

3. Minimum Quality and Quantity: The quality level or quantity shown or specified shall be the minimum required for the work. Except as otherwise indicated, the actual work shall comply exactly with that minimum or may be superior to that minimum within limits acceptable to USDA-ARS. Specified numeric values are either minimums or maximums as indicated or as appropriate for the context of the requirements.

4. Availability of Tradespersons and Manufacturer's Field Services Representatives: At each progress or coordination meeting, review availability of tradespersons, qualified manufacturers representatives required in the specifications, and projected needs to accomplish work as scheduled. Require each entity employing personnel to report on events which might affect progress of work. Where possible, consider alternatives and take actions to avoid disputes and delays

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 LAYING OUT THE WORK

A. Before proceeding to lay out the Work, verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify USDA-ARS promptly.

B. Establish and maintain a minimum of two (2) permanent benchmarks on the site, referenced to data established by survey control points.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Make the log available for reference by USDA-ARS.

D. Existing Utilities and Equipment: Before beginning site work, investigate and verify the existence and location of underground utilities and other construction.

1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping.

2. Furnish location data for work related to the Project which must be performed by public utilities serving the Project site.

3.2 EXAMINATION

A. Examine applicable substrates and conditions under which the Work will be performed before starting construction operations.

B. If unsafe or otherwise unsatisfactory conditions are encountered take corrective action before proceeding. Provide USDA-ARS with a written report documenting the conditions with the corrective actions taken.

3.3 PREPARATION

A. Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Confirm dimensional requirements of the contract documents can be met.

B. Verify space requirements of items shown diagrammatically on Drawings.

3.4 INSTALLATION

A. Locate the Work and components of the Work accurately.

1. Make vertical work plumb and horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and to maximize ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas unless construction documents have designated otherwise.

4. Maintain minimum headroom clearance of *7'-4"* in occupied spaces and *7'-0"* in unoccupied spaces

B. Install products at the time and under conditions that will produce satisfactory results.

1. Maintain temperature, humidity and other weather controls for best performance.

2. Isolate units of non-compatible work to prevent deterioration.

C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

D. Conduct construction operations so that no part of the Work is subjected to damaging operations, or loading in excess of that structurally designed for the occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful or unacceptable levels of noise.

F. Odors and Fumes: To the greatest extent practicable, do not use products that produce harmful or noticeable odors or fumes. If necessary to use such products, coordinate ventilation requirements to produce the ambient condition required for the work and to minimize energy consumption, and to protect personnel from fumes and other harmful effects.

G. Anchors and Fasteners: Provide anchors and fasteners that will withstand stresses, vibration and physical distortion. Anchor each component securely in place, accurately located and aligned with other Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by USDA-ARS.

2. Allow for building movement, including thermal expansion and contraction.

H. Joints: Make like joints of uniform width within contiguous surfaces. Where joint locations in exposed work are not indicated, arrange joints for a uniform and balanced visual effect.

I. Adjust operating components for proper operation

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.6 CORRECTION OF INSTALLED DEFECTIVE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

B. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and proper adjustment of operating equipment.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if the surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired to operate properly.

F. Remove and replace chipped, scratched or broken surfaces.

3.7 CLEANING

A. Maintain the project work areas free of waste material and debris. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

B. Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the work, broom- or vacuum-clean the entire work area.

3. Separate containers of hazardous materials from other waste, and mark containers to identify. Legally dispose of all waste in a timely fashion.

C. Keep installed work clean. Clean installed surfaces in accordance with the recommendations of the manufacturer or fabricator of the product installed, using only the cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and will not damage exposed surfaces.

D. Remove debris from concealed spaces prior to enclosing.

E. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at the time of project completion.

3.8 PROTECTION

A. Protect installed work from soiling and damage.

B. Protective Coverings: Provide appropriate protective coverings for work that might be damaged by subsequent operations. Maintain protective coverings in place until project completion.

END OF SECTION 01 70 00

SECTION 01 73 10 - CUTTING AND PATCHING

PART 1 GENERAL

1.1 SUMMARY

A. This section includes procedural requirements for cutting and patching in existing work.

B. Definition: Cutting and patching includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and repair required to restore surfaces to their original condition. Drilling holes for fasteners and similar operations are not "cutting and patching".

C. Refer to other sections for other requirements and limitations applicable to cutting and patching individual parts of the Work.

D. Coordinate cutting and patching with demolition requirements as specified in 01 73 10 - Cutting and Patching.

E. Coordinate with section 01 74 19 - Construction Nonhazardous Waste Management & Disposal Requirements specified herein Division 1.

1.2 SUBMITTALS

A. Cutting and Patching Plan: In accordance with 01 33 00 - Submittal Procedures, submit a proposal to USDA-ARS's representative, describing procedures at least 14 calendar days in advance of the time cutting and patching will initially be performed.

1. Include the following information, as applicable:

a. Description of the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.

b. Description of the anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in appearance and other significant visual elements.

c. List of products to be used and entities that will perform work.

d. Dates and hours of operation when cutting and patching will be performed.

e. List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be out-of-service temporarily. Indicate how long utility service will be disrupted.

f. Compatibility and cohesion characteristics of patching compounds with adjacent materials.

g. Details and engineering calculations showing integration of reinforcement with the original structure, where cutting and patching involve adding reinforcement to structural elements.

h. Temporary protection of existing structures, surfaces, finishes, equipment, etc. to remain in place during construction.

B. Approval by USDA-ARS to proceed with cutting and patching does not waive the right to later require complete removal and replacement of unsatisfactory work.

1.3 QUALITY CONTROL

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.

B. Operational Limitations: Do not cut and patch operating elements, safety related systems, or related components in a manner that would result in reducing their capacity to perform as intended, or that would result in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in USDA-ARS's opinion, reduce the building's A/Esthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction that is cut and patched in a visually unsatisfactorily manner.

1. Retain the original installer or fabricator to cut and patch exposed work if the original installer or fabricator is identified in the Contract Documents or is known to the Contractor and is available for the work.

2. If it is not possible to engage the original installer or fabricator, engage a Specialist who is specifically experienced in the work.

1.4 EXISTING WARRANTIES

A. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any existing warranties.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use materials identical to existing materials to the maximum extent available.

B. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

C. Use materials whose installed performance will equal or surpass that of existing materials.

D. Materials and/or products used in historic buildings must be approved by USDA-ARS Historic Preservation Staff.

PART 3 EXECUTION

3.1 INSPECTION

A. Before cutting, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

B. Before proceeding with cutting and patching involving two or more trades, meet at the Project site with the entities providing or affected by the cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Before cutting areas of high historic integrity (i.e. zones 1 & 2) as noted on the Historic Building Preservation Plan, these must be reviewed and approved by USDA-ARS Historic Preservation Staff.

3.2 PREPARATION

A. Provide temporary support for work to be cut.

B. Protect existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations. If work is being executed in a historic building then a historic treatment plan is required.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Bypass in-service existing pipe, conduit, or ductwork scheduled to be removed or relocated before cutting.

3.3 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest possible time and complete without delay. Any adverse noise or odor producing work must be performed in accordance with 01 14 00 - Work Restrictions - all delivery methods. Cutting: Cut existing construction using methods least likely to damage elements retained and adjoining construction. Where possible, review proposed procedures with the original installer and comply with the original installer's recommendations.

1. In general, use hand or small power tools designed for sawing or grinding, not for hammering and chopping.

2. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

3. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

4. Cut through concrete and masonry using silicon carbide or harder tipped tools.

5. Comply with requirements of applicable specification sections where cutting and patching requires excavating and backfilling.

6. After utility services are bypassed, cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

B. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Where removed walls or partitions extend one finished area into another finished area, patch and repair floor and wall surfaces to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Where patching occurs in a smooth painted surface, extend the final paint coat over the entire unbroken surface that contains the patch.

5. Patch, repair or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

C. Perform cutting and patching work if listed in 01 14 00 - Work Restrictions - all delivery methods to be performed during Government Unoccupied Hours.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove all evidence of the Work.

B. Thoroughly clean piping, conduit, and similar features before applying paint, restored pipe coverings, or other finishing materials.

END OF SECTION 01 73 10

SECTION 01 74 19 - CONSTRUCTION NONHAZARDOUS WASTE MANAGEMENT AND DISPOSAL ALL DELIVERY METHODS

PART 1 GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including Federal Acquisition Regulation (FAR) and General Services Administration Acquisition Regulation (USDA-ARSR) contract clauses, and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging non hazardous construction and/or demolition (“C&D”) waste.

2. Recycling non hazardous construction and/or demolition waste.

3. Disposing of non hazardous construction and/or demolition waste.

B. Related Requirements:

1. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

Each year, USDA-ARS diverts at least 50% of its total non-hazardous solid waste, including construction and demolition (C&D) debris. Executive Order 14057 section 207 establishes this goal for all Federal agencies. USDA-ARS achieves this goal by estimating current diversion rates, identifying strategies and practices to increase diversion rates, and changing current C&D waste management practices.

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent minimum by weight of total waste generated by the Work unless additional rates are indicated. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1. Mandatory minimum salvage/recycling requirement is 50 percent.

1.5 ACTION SUBMITTALS

A. WASTE MANAGEMENT PLAN

1. General: Use USDA-ARS's *C&D Waste Management Plan and Report* template, or develop a waste management plan according to the requirements of this Section.

2. Waste Management Plan shall consist of waste identification, waste reduction work plan, and, if available, cost/revenue analysis. Revenue from recycling/ scrap proceeds shall be retained by the contractor, and factored into their bids with USDA-ARS, to reduce the government's contract cost. Indicate anticipated quantities by weight or volume, using the same units of measure throughout the waste management plan. Submit plan within *14* days of date established for the Notice to Proceed.

a. List recycling facilities, reuse facilities, municipal waste landfills and other disposal area(s) to be used. Include:

1) Name, location, and phone number.

2) Copy of permit or license for each facility.

b. Revise and resubmit Plan if required by USDA-ARS.

1) Approval of Contractor's Waste Management Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

3. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and/or construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

4. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

a. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

b. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include a list of their names, addresses, and telephone numbers.

c. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include a list of their names, addresses, and telephone numbers.

d. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

e. Disposed Materials: Identify materials that cannot be recycled or reused. Provide explanation or justification. Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incineration facility.

f. Handling and Transportation Procedures: Include methods that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, electronically submit reports in PMIS for construction waste and for demolition waste. Include the following information:

1. Material category.

2. Generation point of waste. (Building address)

3. Total quantity of waste in tons.

4. Quantity of waste salvaged, both estimated and actual in tons.

5. Quantity of waste recycled, both estimated and actual in tons.

6. Total quantity of waste recovered (salvaged plus recycled) in tons.

7. List of Materials made from recycled materials/bio-based materials and their cost (not including installation costs) purchased for use on this project.

8. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Landfill and Incineration Disposal Records: Indicate receipt and acceptance of waste by landfills and incineration facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement a waste management plan during the entire duration of the Contract.

1. Comply with 01 50 00 Temporary Facilities and Controls for operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within *3* days of submittal return.

2. Distribute Waste Management Plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

D. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 300 mm **(**12 inches) or more.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with labels indicating elements, date of removal, quantity, and location where removed.

3. Store items in a secure area until installation.

4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for sale and/or donation are not permitted on the Project site.

C. Salvaged Items for the Government's Use: Salvage items for the Government's use and handle as follows:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with labels indicating elements, date of removal, quantity, and location where removed.

3. Store items in a secure area until delivery to USDA-ARS.

4. Transport items to the Government's storage area *designated by USDA-ARS*.

5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.3 RECYCLING CONSTRUCTION AND DEMOLITION WASTE, GENERAL

A. General: Recycle paper (bond or newsprint) and beverage containers (glass, plastic or aluminum) used by on-site workers.

B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from the Project site. Include a list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Remove recyclable waste from the work site, and transport it to a recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Clean and stack undamaged, whole masonry units on wood pallets.

B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

C. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.

2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

D. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

E. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation or recycling organization.

F. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

G. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from the Government's property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. See section III of the Agreement for Definition of Substantial Completion.

B. All electronic record documents submittals shall be uploaded to USDA-ARS's electronic Project Management (USDA-ARS's Project Management System) system.

C. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:

1. Substantial Completion procedures.
2. Project record document submittal.
3. Operation and maintenance manual submittal.
4. Final cleaning
5. Repair of the Work.

D. Closeout requirements for specific construction activities are included in the individual sections in Divisions 2 through 28.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for Substantial Completion, complete the following.

1. Submit closeout submittals from other Division 1 sections, project record documents including electronic documents, operation and maintenance manuals, final project photographs, damage or settlement survey, and utility lines survey.
2. Warranties and guarantees shall not begin until substantial completion. Warranties and guarantees for any equipment that comes on line at a later date which is accepted by the Government shall commence on that date.
3. Contractor shall make final changeover of permanent locks and transmit all keys (including duplicates) to USDA-ARS. Complete startup testing of systems and instruction of the Government operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements. Submit test/adjust/balance records.
4. HVAC Balance and Testing must be completed within seasonal limitations.
5. Commissioning must be completed within seasonal limitations.
6. Warranty of any systems or items being used during the occupancy period shall have been completed and submitted at the time of government's written acceptance including the date for Notice of Substantial Completion. The Authority Having Jurisdiction is the Government.
7. The punch list of non-completed work and items shall be entire, valued, and submitted.
8. Completion of punch list items must be completed within one month.
9. The electronic format for Operations and Maintenance materials must contain word search features.

B. Inspection Procedures: On receipt of a request for inspection, USDA-ARS will either proceed with inspection or advise the Contractor of unfulfilled requirements. USDA-ARS will notify the Contractor of Substantial

Completion following the inspection or advise the Contractor of construction that must be completed or corrected before Substantial Completion.

1. USDA-ARS will repeat the inspection when requested and when assured that the Work is substantially complete.
2. Results of the completed inspection will form the basis of the requirements for Final Acceptance.
3. Items that are not included on the punch-list will not relieve the Contractor from performing all work required and in accordance with the construction documents.

1.3 FINAL ACCEPTANCE FOR CONTRACT COMPLETION

A. Preliminary Procedures: Before requesting re-inspection for Final Acceptance, complete the following:

1. Submit an updated final statement, accounting for final additional changes to the Contract price.
2. Submit a certified copy of the previous Substantial Completion inspection list of items to be completed or corrected. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance, and shall be endorsed and dated by the Contractor.
3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents. State warranty commencement dates.
4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item.
5. Deliver tools, spare parts, extra stock and similar items.
6. Complete final clean-up requirements including touch-up painting of marred surfaces.
7. At the end of the acceptance submit final payment request with releases and supporting documentation not previously submitted and accepted.

B. Re-inspection Procedure: USDA-ARS will re-inspect the Work upon receipt of notice from the Contractor that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to USDA-ARS.

1. Upon completion of re-inspection, USDA-ARS will notify the Contractor of Final Acceptance or will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled and are required for Final Acceptance.
2. If necessary, re-inspection will be repeated.

C. Contractor's Responsibility for Re-Inspection Following Substantial Completion: If the final completion or acceptance is delayed for more than thirty (30) calendar days following substantial completion through no fault of the Government, CM, or the A/E; the Contractor shall be responsible for the Government's additional costs associated with re-inspections. During this 30-day period, the CM and/or A/E will make only one (1) re-inspection to verify completion of the punch list. Any additional re-inspections, administrative services, or direct costs will be considered CM and/or A/E additional services. The Government's actual costs for CM and/or A/E additional re-inspections, administrative services, or direct costs will be charged to the Contractor through an appropriate contract modification in the form of a credit to the Government.

D. Contractor's Responsibility for Repeated Efforts to Commission: If acceptance is delayed for more than 30 calendar days following the initial efforts to commission through no fault of the Government, CM, or the A/E; the Contractor shall be responsible for the Government's additional costs associated with resolving continued commissioning efforts. During this 30-day period, the CM and/or A/E will make only one (1) additional effort to resolve and commission. Any additional effort to resolve and commission, administrative services, or direct costs will be considered CM and/or A/E additional services. The Government's actual costs for CM and/or A/E additional effort to resolve and commission, administrative services, or direct costs will be charged to the Contractor through an appropriate Change Order.

1.4 RECORD DOCUMENT SUBMITTALS

A. Certificate of Insurance: For continuing coverage.

B. Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for USDA-ARS's reference during normal working hours.

C. Record As-Built Drawings: Maintain both electronic media copies and a clean, undamaged set of blue or black line white-prints of all Contract Documents. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark the drawing that is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Electronic record copies showing changes shall be done clearly such that the changes are understood so that they can be constructed. Upload to USDA-ARS's Project Management System.

1. Mark record print sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.
2. Mark new information not shown on Contract Drawings or Shop Drawings.
3. Note related modification numbers where applicable.
4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets. Print suitable titles, dates, and other identification on the cover of each set.

D. Record Specifications: Maintain one complete copy of the Specifications with addenda. Include one copy of other written construction documents, such as modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the original contract Specifications and modifications.
2. Give particular attention to substitutions and selection of options, and information about concealed construction that cannot otherwise be readily determined later by direct observation. Provide digital photos or videos of construction areas before being concealed.
3. Note related record drawing information and Product Data.

E. Record Product Data: Maintain one copy of each Product Data submittal. Note related modifications and markups of Record Drawings and Specifications.

1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
2. Before concealing areas document with digital photos or video on a CD or DVD. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily determined later by direct observation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

B. Use cleaning products that comply with Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable Volatile Organic Compounds (VOC) levels.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Government's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following:

1. Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package as individual electronic PDF files.
2. Operation and Maintenance manuals.
3. Material and Finishes Maintenance Manuals
4. Record documents.
5. Photo CDs or DVDs of any hidden or concealed construction areas.
6. Spare parts and materials.
7. Attic stock.
8. Tools.
9. Lubricants.
10. Fuels.
11. Identification systems.
12. Control sequences.
13. Hazards.
14. Cleaning.
15. Warranties and bonds.
16. Maintenance agreements and similar continuing commitments
17. Keys, security hardware or security information.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Startup.
2. Final commissioning coordination.
3. Shutdown.
4. Emergency operations.
5. Noise and vibration adjustments.
6. Safety procedures.
7. Economy and efficiency adjustments.
8. Effective energy utilization.

3.2 FINAL CLEANING

A. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial cleaning and maintenance program. Comply with manufacturer's instructions.

B. Do not use caustic or acidic cleaning materials that will mar or etch finished work.

1. Complete the following cleaning operations before requesting inspection for Final Acceptance.
    a. Remove labels that are not permanent labels.
    b. Clean transparent materials, including mirrors and glass in doors and windows. Removing glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
    c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean. Vacuum carpeted surfaces on floors and soft surfaces in any other location.
    d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean interiors of all ductwork to render facility safe for human occupancy.
    e. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

C. Removal of Protection: Remove temporary protection and facilities installed for the protection of the Work during construction.

D. Compliance: Comply with the regulations of authorities having jurisdiction and with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Government property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of it lawfully.

E. Remaining Materials of value that remain after completion of associated work, become Government property. Dispose of or salvage/recycle these materials as directed by USDA-ARS.

3.3 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition. All components of the construction including operational and material shall be in new condition and new working order at the completion of Repair of the Work.

END OF SECTION 01 77 00

SECTION 01 78 10 - PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements that the Contractor must perform with regards to Project Record Documents. These include but are not limited to those defined in Part B. Electronic records that show identifiable changes shall be done. The following normally must be included, and the Contractor is required to show any other changes not listed below:

B. All electronic project record documents shall be uploaded to PMIS.

1. Marked-up copies of Contract Drawings.
2. Marked-up copies of Shop Drawings.
3. Newly prepared record drawings.
4. Marked-up copies of Specifications, addenda, and Change Orders.
5. Marked-up Product Data submittals.
6. Record Samples.
7. Field records for variable and concealed conditions.
8. Record information on Work that is recorded only schematically.
9. Operating manuals with a schematic diagram, sequence of operation, and system operating criteria for each system installed. Training materials and videos. Equipment maintenance manuals with complete information for all major components.

C. Maintenance of Documents and Samples: Store both electronic media and hard copy Record Documents and samples in the field office apart from the Contract Documents used for construction in clean, dry conditions. They shall be readily accessible. Do not use Project Record Documents for construction purposes. All electronic Project Record Documents should be uploaded to PMIS.

1.2 RECORD DRAWINGS

A. Markup Procedure: During construction, the Contractor shall maintain a set of black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes. Contractor shall mark these Drawings to show all changes that have been done. If BIM is not used, the Contractor shall maintain a copy of the Contract Document CAD files showing these changes to the physical conditions.

1. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions sufficient to construct the changes. Where Shop Drawings are marked, show cross-reference on Contract Drawings location. Identify each change to coordinate with accompanying, if any, Record Documents.

2. Mark hard copy record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Both the bound, organized, and labeled hard copies and the electronic media shall be submitted prior to Final Acceptance.

B. Copies Distribution: After completing the preparation of Record Documents, the Contractor shall provide electronic media of each drawing, whether or not changes and additional information were recorded. These full sets will be the hard copy of record drawings for filing purposes; they are not intended for use in later maintenance on the facility. Organize the copies into manageable sets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

1. Organize and bind original marked-up sets of prints that were maintained during the construction period in the same manner.

2. Organize records into sets matching the print sets. Place these sets in durable tube-type drawing containers with end caps. Mark the end cap of each container with suitable identification.

3. Submit the marked-up record set, transparencies, and the copy sets to the Contracting Officer for the Government's records.

B. Newly Prepared Construction Drawings into Record Drawings: When neither the original Contract Drawings nor Shop Drawings are not suitable for converting into ion, record drawings prepare new drawings instead of following procedures specified in part A. These new drawings will be fully developed as contract drawings. New drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

1. Provide Drawings in a scale that allows for the scope of detailing and notations required to record the actual physical installation and its relationship to other construction.

2. When completed and accepted, integrate newly prepared Drawings with procedures specified for organizing, copying, binding and submitting record drawings.

1.2 RECORD SPECIFICATIONS

A. During the construction period, the Contractor shall maintain the Project Specifications, including addenda and other modifications issued, for Project Record Document purposes.

1. Mark the Specifications or provide new or edited Specifications to indicate the actual installation where the installation varies from that indicated in Specifications. Provide dates and other identifying information to discriminate them from the existing Specifications. These shall be fully coordinated with the other contract documents.

a. In each Specification section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.

b. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.

c. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

2. Upon completion of markup, submit above mentioned Record Specifications to the Government in electronic mediums.

1.3 RECORD PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal.

1. Mark Product Data to indicate the actual product installation where the installation varies from that indicated in Product Data submitted. Include changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.

2. Give particular attention to information about concealed products and installations that cannot be readily identified and recorded later.

3. Note related Change Orders and markup of Record Drawings, where applicable.

4. Upon completion of markup, submit a complete set of record Product Data to the Government. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.

1.4 MISCELLANEOUS RECORD SUBMITTALS

A. Refer to other Specification sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Prior to Final Acceptance, complete Miscellaneous Records and place them in good order, properly identified and bound or otherwise organized to allow for use and reference.

B. Submit to the Government.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01 78 10

SECTION 01 78 22 - OPERATION AND MAINTENANCE DOCUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. This section includes administrative and procedural requirements for operation and maintenance electronic and hard copy manuals and instructions, including the following:

1. Instruction manuals covering the care, preservation and maintenance of materials and finishes.

2. Operation, maintenance, troubleshooting and parts manuals for equipment and building operating systems.

3. Instruction of Government operating personnel in the operation and maintenance of building systems and equipment.

4. Equipment inventories.

5. Emergency manuals.

6. Contractor shall load manuals into PMIS and provide paper *(1)* hard copies for USDA-ARS's Office of Facilities Management (OFM) review.

B. Additional Requirements:

Refer to all of the individual Specification sections for additional requirements for the care and maintenance of materials and finishes, and for the operation and maintenance of the various pieces of equipment and operating systems and for manual preparation.

1. Division 01 33 00 - Section for Submittal Procedures.

2. Division 01 77 00 - Section Closeout Procedures.

1.2 QUALITY CONTROL

A. Operation and Maintenance Manual Preparation: In preparation of manuals, use personnel thoroughly trained and experienced in the maintenance of the material or finish involved, or in the design, operation, maintenance and manufacturing of the equipment or system involved.

1. Where manuals require written instructions, use the personnel skilled in technical writing where necessary for communication of essential data.

2. Where manuals require drawings or diagrams, use draftspersons capable of preparing drawings clearly in an understandable and transferrable format.

B. Instruction of Government Personnel: Use instructors thoroughly trained and experienced in the design, operation maintenance and manufacturing of the equipment or system involved to instruct Government operation and maintenance personnel.

1.3 SUBMITTALS

A. Submittal Schedule: Comply with the following schedule for submitting the aforementioned electronic manuals:

1. Make corrections or modifications to comply with the Government's comments.

2. Submit copies of each approved manual to the Government within *21* calendar days, before training government personnel, and after receipt of the Government's comments.

B. Format: Upload in PMIS and submit operations and maintenance and related electronic manuals in the following format:

1. PDF file and unlocked native electronic version, i.e. Word, Excel, etc. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to USDA-ARS.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.

b. Enable inserted reviewer comments on draft submittals.

PART 2 PRODUCTS

2.1 MANUAL CONTENT

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. Table of Contents

2. List of documents.

3. List of systems.

4. List of equipment.

5. In each manual, include information specified in the individual Specification sections and the following information where applicable for each major component:

a. General material, finish, system or equipment description.

b. Design factors and assumptions

c. Copies of applicable Shop Drawings and Product Data.

d. Material, finish, system or equipment identification, including but not limited to:

1) Name of manufacturer with contact information.

2) Model number.

3) Serial number of each component.

e. Equipment operating data: The data includes but is not limited to:

1) Equipment Type

2) Equipment Set Points as commissioned for all seasons and/or setback controls.

3) Equipment Descriptions.

4) Manufacturer.

5) Model Number.

6) Serial Number.

7) Equipment Status

8) Install date

9) Life Cycle End Date / Estimated EOL

10) Manufacture Date

11) Quantity (1..n)

12) USDA-ARS Region, Service Address (USDA-ARS Building Name and Code)

13) ☐ Run to Fail? (“Do not maintain?”)

14) Warranty Exp. Date

15) Purchase Price

16) Replacement Cost

17) Specifications – Asset Attributes per COBie and BIM specs.

18) Electrical Motor Start Up and Running Data including but not limited to Amps, Volts, Locked Rotor and Running

19) Building Number and Location including floor # and mechanical room #.

20) Operation instructions.

21) Emergency instructions.

22) Wiring diagrams.

23) Inspection and test procedures.

6. Maintenance procedures and schedules, including, where applicable, preventative and predictive maintenance.

7. Parts list

8. Troubleshooting guide

9. Precautions against improper use and maintenance.

10. Copies of warranties and service contracts.

11. Repair instructions, including listings of spare parts for equipment.

12. Sources of required maintenance materials and related services.

B. Format: Organize each manual into separate sections for each related product or piece of equipment. Each manual shall contain a title page, table of contents, general information, copies of Product Data, written text, drawings and copies of each warranty and service contract issued.

1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. As a minimum, provide the following information:

a. Subject matter covered by the manual.

b. Name and address of the Project.

c. Name of Government user agency.

d. Date of submission.

e. Name, address, and telephone number of the Contractor.

f. Cross-reference to related products in other operation and maintenance manuals, if applicable.

2. Table of Contents: After title page, include a typewritten table of contents for each emergency, operation, and maintenance volume: arranged systematically according to the Specifications format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume. Where more than one volume is required to accommodate the data, provide a comprehensive table of contents for all volumes in each volume of the set.

3. General Information: 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 subcontractor or installer and the maintenance contractor. Clearly delineate the extent of responsibility for each of these entities. Include a local source for replacement parts for equipment.

4. Product Data: Where the manuals include manufacturer's standard printed data, 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 the Project includes more than one item contained in the product data, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.

5. Written Text: Prepare text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper maintenance of materials or finishes, or for proper operation and maintenance of equipment or systems. Provide customized text for this project that explains the system's operation and design intent. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure, the sequence of operation, seasonal operational changes, and night time setbacks.

6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

7. Warranties and Service Contracts: Provide a copy of each warranty or service contract in the appropriate manual for the information of the Government's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect the validity of warranty.

C. When required for full understanding, include a copy of applicable Project Record Drawings.

2.2 INTERIOR FINISHES MAINTENANCE MANUAL

A. Submit electronic copy of each material and finish in PDF format, to USDA-ARS. Provide one section for architectural products, including applied materials and finishes.

B. Architectural Products: Provide manufacturer's data and instructions for the care and maintenance of architectural products, including applied materials and finishes.

1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:

a. Manufacturer's catalog number and contact information.

b. Size.

c. Material composition.

d. Color.

e. Texture.

f. Repairs to finish where applicable

g. Reordering information for custom manufactured products.

2. Care and Maintenance Instructions: Provide care and maintenance information, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information about cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.

2.3 EQUIPMENT AND SYSTEMS OPERATION AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem and a separate section for each piece of equipment not part of a system. The Title page and Table of Contents shall be as described herein above.

B. Submit in PDF format as per Submittals herein, and per instruction of the Government.

C. Submit 1 copy of each equipment and systems maintenance manual, in final form, to the Government. Provide separate manuals for each unit of equipment, each building operation system, and each electric and electronic system.

D. Equipment and Systems: Provide the following information for each piece of equipment, each building operation system, and each electric or electronic system, where applicable: Use designations for systems and equipment indicated in Contract Documents. See requirements in other mechanical, electrical, plumbing, etc. specification sections. Provide a list to the USDA-ARS project manager and building manager (aka property manager) at 50% construction complete.

1. Description: Provide a complete description of each unit and related component parts, including the following, as applicable:

a. Equipment or system function.

b. Operating characteristics.

c. Limiting conditions.

d. Performance curves.

e. Engineering data and tests.

f. Line diagrams with linkages to other equipment and systems

g. Complete nomenclature and number of replacement parts

h. Equipment Type using National CAD Standard (e.g. AHU-1).

i. Equipment Description

j. Manufacturer Model & Serial Numbers

k. Equipment location including building number, location, floor #, room #, narrative of location (i.e. west wall, above ceiling panel, etc.)

2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following, as applicable:

a. Printed operation and maintenance instructions.

b. Assembly drawings and diagrams required for maintenance.

c. List of items recommended to be stocked as spare parts.

3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following, as applicable:

a. Routine operations.

b. Preventative maintenance

c. Predictive maintenance

d. Troubleshooting guide.

e. Disassembly, repair, and reassembly.

f. Alignment, adjusting, and checking.

4. Operating Procedures: Provide information on equipment and system operation procedures, including the following, as applicable:

a. Startup procedures.

b. Equipment or system break-in.

c. Routine and normal operating instructions.

d. Regulation and control procedures.

e. Instructions on stopping.

f. Shutdown and emergency instructions.

g. Summer and winter operating instructions.

h. Required sequences for electric or electronic systems.

i. Special operating instructions.

5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.

7. Piping Identification: Provide as-installed, color-coded, piping diagrams, where required for identification.

8. Valve Tags: Provide charts of valve-tag numbers, with the location and function of each valve.

9. Circuit Directories: When another Contractor (not the O&M Contractor) adds or modifies electric circuits the O&M Contractor shall inform the CO or designee the compliance of annotating the changes to the panel and the update to the single line diagrams using the original electronic file format. For electric and electronic systems, provide complete circuit directories of panel-boards, including the following, as applicable:

a. Electric service.

b. Controls.

c. Communication

d. Single Line Diagrams updated at no additional cost.

E. Schedule: Provide complete information in the equipment and systems manual on products specified.

F. Provide an integrated service schedule/matrix for HVAC, Electrical, and Fire that indicates all systems daily, weekly, monthly, yearly, etc. service requirements and operational characteristic checks. Cross reference to O&M manual section for requirements.

2.4 INSTRUCTIONS FOR GOVERNMENT PERSONNEL

A. Prior to the Substantial Completion inspection, instruct the Government's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed times.

B. Use operation and maintenance manuals for each product, piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

C. Posted Logs and Instructions: Place operating logs and instructions in see-through vinyl or other weather protective sleeves or framed enclosures, and post for use by Government personnel in locations approved by the Government.

1. Post operating log sheets with spares at or near the applicable equipment.

2. Post flow schematics, wiring diagrams, valve lists, control sequences, start-up and shut-down instructions, and similar information and instructions in the appropriate equipment rooms.

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01 78 22

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and 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.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit within seven of end of each training module.

1. At completion of training, submit complete training manual(s) for the Government’s use prepared in same format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. 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.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

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. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. 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.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with the Government through the Contracting Officer’s Representative (COR**)** with at least fourteen days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 79 00

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2012) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6	(2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of tearing apart and removing any feature of a facility together with any related handling and disposal operations.

1.2.1.2 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.2 Demolition Plan

Prepare a Demolition Plan and submit proposed demolition and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be

salvaged, coordination with other work in progress, a disconnection schedule of utility services and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan must be approved by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Comply with FAR 52.236-9 to protect existing vegetation, structures, equipment, utilities, and improvements. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of trench walls to prevent settlement or other movement.

1.3.2 Trees

Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place, by an orange construction snow fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the utility provider and disconnected and sealed by the Contractor.

1.3.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will be permitted between the hours of 7 am and 5 pm. Where burning is permitted, adhere to Federal, State, and Local regulations.

1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available at contract award.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan; G

Existing Conditions; G

SD-07 Certificates

Notification; G

1.7 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency, local air pollution control district/agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.7.1 Debris Control

Prevent the spread of debris on-site and off-site and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited

to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in tracking of sediment onto public roads.

1.8 PROTECTION

1.8.1 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the manhole removal locations being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.9 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer or the Contracting Officer's Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs or electronic images with a minimum resolution of 3072 x 2304 pixels, capable of a print resolution of 300 dpi, will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results to the Contracting Officer.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition of structures.

b. Provide fill material conforming to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material must be free from roots and other organic matter, trash, debris, frozen materials,

   and stones larger than 2 inches in any dimension.

c. Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Disassemble existing construction scheduled to be removed for reuse. Dismantled and removed materials are to be separated, set aside, and prepared as

specified, and stored or delivered to a collection point for reuse, recycling, or other disposal, as specified. Designate materials for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed as indicated on drawings.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Paving and Slabs

Remove sawcut concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 12 inches below existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated. Remove pavement and slabs from the project site at Contractor's expense.

3.1.4 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, abut or tie the new work into the existing construction as indicated for the new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.

3.1.5 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Sawcuts in existing concrete must be at the nearest existing expansion joint or weakened plane joint and at full depth.

3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Make finished surfaces of patched area flush with the adjacent existing surface and match the existing adjacent surface as closely as possible to texture and finish. Provide patching as specified and indicated, and include the following:

a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.1.7 Mechanical Equipment and Fixtures

3.1.7.1 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. If the piping that remains can become pressurized due to upstream valve failure, attach end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.8 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Fill holes and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, become the property of the Contractor and must be removed from Government property. Materials approved for storage by the Contracting Officer must be removed before completion of the contract. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed within 5 miles of the work site.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. Coordinate the salvaged materials with tracking requirements in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Capture salvaged materials in the diversion calculations for the project.

c. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.3.3 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in a legal manner. Dispose of unsalvageable and non-recyclable combustible material in a legal manner.

3.4 CLEANUP

Remove debris and rubbish from project site and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified. Storage of removed materials on the project site is prohibited.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior and interior of building and site elements.
2. Removal of existing items for reinstallation.
3. The work shall be done within an existing laboratory building that will remain fully operational thought the project. Staff will continue to utilize existing facilities, including corridors throughout the project.

B. Related Requirements:

1. Section 01 10 00 "Summary" for restrictions on use of the premises, Government-occupancy requirements, and phasing requirements.
2. Section 01 32 33 'Photographie Documentation' for pre-démolitions photographes.
3. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
4. Section 01 73 00 "Cutting and Patching" for cutting and patching procedures.
5. Section 01 35 16 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
6. Section 31 11 00 "Clearing and Grubbing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

C. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS GOVERNMENTSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Government's operations. Comply with the Government's requirements for working within existing laboratory spaces.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project Site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review and finalize protection requirements.
7. Review procedures for noise control and dust control.
8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

A. Survey of Existing Conditions: Submit Contractor's Pre-Demolition survey.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Government's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Government's continuing occupancy of portions of existing building and of Government's partial occupancy of completed Work.

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 QUALITY ASSURANCE

A. The work shall be done by workers qualified to perform selective demolition within an occupied laboratory building.

1.8 FIELD CONDITIONS

A. Government will occupy portions of the existing building immediately adjacent to and within the selective demolition area. Conduct selective demolition so Government's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purposes will be maintained by Government as far as practical.

C. Notify the Government of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. Hazardous materials will be removed by Government before start of the Work.
b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify COR and Government. Hazardous materials will be removed by Government under a separate contract.

E. Existing Areas: Demolition and hauling equipment and other materials to be of sizes that clear surfaces within spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.
1. The existing southeast entrance to Building 1 will remain open and active for staff entrance, egress and emergency egress throughout the work.
2. Provide temporary protection at the entrance to allow for staff use throughout the work.
3. Prepare and review plans for the protection with the Government prior to commencement of the work. Review protections installed with the Government as the Government may request.

F. Historic Building: The existing Building 1 has historic importance and is eligible for historic registration. This includes stone and brick masonry façade areas surrounding the existing southeast entrance. Also included is the existing entry metal and glass storefront, stone flooring, walls and ceilings at the entrance and entrance vestibule and stairs.
1. Photograph existing façade, entrance and vestibule noted above specifically prior to starting the work.
2. Protect existing façade, entrance and vestibule noted above as may be required to prevent damage throughout the work.
3. Prepare and review plans for the protection with the Government prior to commencement of the work. Review protections installed with the Government as the Government may request.

G. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Government. Government does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video. Comply with Section 01 32 33 "Photographic Documentation."

1. Inventory and record the condition of items to be removed for reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Government, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

C. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

D. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.

1. Government will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
4. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

5. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

    a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
    b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Government.

3.3 REINSTALL

A. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least four hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, entrances or other adjacent occupied or used facilities without permission from Government and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. Recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. American Concrete Institute (ACI) Specifications ACI 318 and ACI 360.

C. Portland Cement Association (PCA) Supporting Publications for Concrete Design and Execution.

D. American Society for Testing and Materials (ASTM)

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Building Footings and Foundation Walls.
2. Floor Slab on Grade
3. Door Stoops and Sidewalks
4. Equipment Foundation Pads
5. Misc. Exterior Concrete

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated on drawings and below.

B. Design Mixtures: For each concrete mixture design submit with shop drawings at least 30 days prior to first concrete placement and include all additives and the compressive strength tests. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld at batch plant for later addition at Project site. Note, mixing water may not be added at the Project Site unless approved on a per truck basis by the Contracting Officer.
2. Indicate admixtures and/or products planned to be added on site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Contracting Officer.

E. Product Data / Specifications and written Manufacturer Installation Requirements for slip dowels, and /or other products embed or cast into concrete.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installers, Manufacturer, and or Suppliers and any testing agencies.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semi rigid joint filler.
12. Joint-filler strips.
13. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
2. Where Self Consolidating Concrete is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated or otherwise acceptable to the Contracting Officer.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Not required for this project.

I. Preinstallation Conference: Conduct conference at project site or as arranged.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

2. Review special construction observation and testing and testing agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction, contraction and isolation joints, and joint-filler strips, semi rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, concrete travel times to the project site, and concrete protection as applicable to the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging any coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth

concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed if specified or allowed on the drawings.

C. Deformed or Plain-steel Welded Wire Reinforcement: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets or bars.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

1. System Components: Reusable base and plastic sleeve.

a. Material: Polypropylene plastic.

2. Size: To accept slip dowels of the diameter and length shown on the drawings.

B. Plate Dowel System: For construction joints.

1. System Components:

a. High density plastic sleeve pocket former and insert to properly position load plate dowel for axial and lateral shrinkage capability.
b. Steel load plate dowel: Hot rolled steel plate meeting ASTM A 36.

2. Speed Plate Dimensions: minimum 1/4 inch (6.4 mm) thick by 4 x 6 inch (102 x 152 mm) load plate dowel or as shown on drawings.
3. Spacing: Per drawings.

C. Tie Wire: To be FS QQ-w-461, annealed steel, black, 16-gauge minimum.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Clas 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project for concrete having exposed-to-view finished surfaces:

1. Portland Cement or Blended Portland Cement: ASTM C 150, C 845, C595 Types I, IA, II or IIA.
2. Fly ash, slag, or pozzolanic materials may slow rate of concrete strengthening and affect color uniformity. Availability of Class F fly ash predominates over Class C fly ash.

a. Fly Ash: ASTM C 618, Class F or C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal or as specified on the drawings.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M. Clean and free from injurious amounts of oil, salt, acid, alkali organic matter or other deleterious substances. Conforming to requirements of ASTM C1602.

2.5 ADMIXTURES

A. Chemical Admixtures: Provide admixtures from a single manufacturer and certified by manufacturer to be compatible each other. Admixtures must be reviewed and approved by the Contracting Officer and in

some cases code officials or state regulators for each project. Use and dosage is highly dependent on weather, local materials and the specific project.

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

    a. Water Reduction: Minimum 5 percent.
    b. Shall contain no calcium chloride.

3. Mid-Range Water-Reducing Admixture: ASTM C 494/C 494M, Type A and F.

    a. Water Reduction: 6 percent to 11 percent.
    b. Shall contain no calcium chloride.

4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

    a. Water Reduction: Minimum 12 percent.
    b. Shall contain no calcium chloride.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Workability Enhancing Admixtures: ASTM C 494/C 494M, Type S.
7. Set Retarding and Hydration Stabilizers: ASTM C 494/C 494M, Type B and D.
8. Set-Accelerating Admixtures:

    a. Non-Chloride Based Accelerator, ASTM C 494/C 494M Type C or C and E:
    b. Non-Chloride Based Hardening Accelerator. ASTM C 494/C 494M Type C:
    c. Chloride Based Accelerator:

9. Viscosity Modifying Admixtures: ASTM C 494/C 494M, Type S:
10. Permeability Reducing Admixtures:

    a. Hydrophobic Pore blocking Admixture, ASTM C 494/C 494M, Type S:

        1) Permeability: Minimum percent reduction in permeability through concrete treated with hydrophobic waterproofing admixture when tested in accordance with COE CRD C-48 shall meet as supported by testing data.
        2) Water Penetration: Manufacturer must provide independent testing report that shows concrete treated with hydrophobic waterproofing admixture has the capability to reduce water penetration into concrete as compared to control mix, when measured by EN 12390-8/DIN 1048.
        3) Water Absorption: Manufacturer must provide independent testing report that shows concrete treated with hydrophobic waterproofing admixture has the capability of reducing water absorption into concrete as compared to control mix, when measured per ASTM C 1585.
        4) Freeze-Thaw Durability: Hydrophobic waterproofing admixture must show increased freeze-thaw durability when compared to reference concrete, per ASTM C 666 if applicable to the project.
        5) Alkali-Silica Reactivity: In order to limit the susceptibility of ASR issues in concrete treated with waterproofing admixture, the sodium oxide equivalent of the waterproofing admixture shall be no more than 0.40 percent when measured in accordance with BS EN 480-12:1988.

6) British Board of Agreement (BBA) - Water Tightness Test system Document.
7) Compressive Strength: Manufacturer must provide independent testing report that shows concrete treated with hydrophobic waterproofing admixture has the capability to increase 7-day and 28-day strength by at least 10 percent when compared to untreated concrete, as measured by ASTM C 39.
8) Drying Shrinkage: Manufacturer must provide independent testing report that shows concrete treated with waterproofing admixture has the capability to reduce drying shrinkage when compared to untreated concrete at the same slump, as measured by ASTM C 157.
9) Plastic Properties: Manufacturer must provide independent testing report that shows concrete treated with hydrophobic waterproofing admixture does not have any significant effect on the plastic properties of concrete, including:

a) Air Content, as measured by ASTM C 231.
b) Set Times, as measured by ASTM C 403.

10) ANSI/NSF Standard 61 compliant for use in contact with potable water.

b. Crystalline Admixture:

1) ANSI/NSF Standard 61 compliant for use in contact with potable water.
2) Uses insoluble crystalline compounds to block capillary pores.
3) Crack sealing ability up to specified crack width.
4) Water Penetration: Manufacturer must provide independent testing report that shows concrete treated with crystalline waterproofing admixture has the capability to reduce water penetration into concrete as compared to control mix, when measured by EN 12390-8/DIN 1048.
5) Drying Shrinkage: Manufacturer must provide independent testing report that shows concrete treated with crystalline waterproofing admixture has the capability to reduce drying shrinkage when compared to untreated concrete at the same slump, as measured by ASTM C 157.
6) Freeze-Thaw Durability: Crystalline waterproofing admixture must show increased freeze-thaw durability when compared to reference concrete, per ASTM C 666.
7) Permeability: Minimum percent reduction in permeability through concrete treated with crystalline waterproofing admixture when tested in accordance with COE CRD C-48 at 200 psi (462 feet water pressure).
8) Water Absorption: Manufacturer must provide independent testing report that shows concrete treated with crystalline waterproofing admixture has the capability of reducing water absorption into concrete as compared to control mix, when measured per ASTM C 1585.

11. Shrinkage Reducing/Compensating Admixtures:

a. Shrinkage-reducing/compensating admixture having the following characteristics:

1) Designed to provide BOTH of the following characteristics:

a) Expands at a rate that closely compensates for the shrinkage of the concrete mix.
b) Reduces the capillary surface tension of the concrete pore water.

2) Provides at least 80% shrinkage reduction as measured and documented by field performance.
3) Formulated for use in freezing and thawing weather.
4) Dosage rate and mixing sequence shall be per manufacturer's recommendations.
5) Shall have documented performance of ASTM C1581, Ring Test, run with concrete (maximum aggregate size not to exceed 0.5 inches): No cracking for minimum 120 days.
6) Shall be certified by NSF/ANSI Standard 61: Drinking Water System Components – Health Effects.

12. Alkali-Silica Mitigating Admixture:

a. Dosage: According to CRD C 662.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A minimum 10 mil thickness for slabs on grade unless shown otherwise on project drawings. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Moisture-Retaining Cover: Natural cellulose fiber encapsulated fabric sheeting capable of 7 or 14 day wet curing while maintaining 100 percent relative humidity.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Types I and II, non-load bearing or
2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete as shown on the project drawings.

F. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

G. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.8 CONCRETE MIXTURES, GENERAL

A. Recycled Content of Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.

B. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 as defined in ACI 318.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

C. Cementitious Materials: May be fly ash, pozzolan, ground granulated blast-furnace slag, and / or silica fume to reduce the total amount of Portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: Class C: 20 percent; Class F: 15 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement unless concrete will not be exposed to moisture.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.9 CONCRETE MIXTURES (unless the project drawings specify more restrictive)

A. Footings not susceptible to freeze-thaw: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days unless the project drawings require higher strength.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 7 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).

B. Grade Walls susceptible to freeze-thaw: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days unless the project drawings require higher strength.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
4. Slump Limit: 7 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

C. Interior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days unless the project drawings require higher strength.
2. Maximum Water-Cementitious Materials Ratio: 0.45
3. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu.m).
4. Slump Limit: 7 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 1 to 3 percent at the point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

D. Exterior Slabs-on-Grade (including door stoops, sidewalks, exterior equipment foundations, and misc. exterior concrete): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days unless the project drawings require higher strength.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
4. Slump Limit: 7 inches (125 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish the complete batch ticket information.

1. The number of revolutions of the drum or blades at mixing speed shall not be less than 70 nor more than 100 total revolutions per batch.
2. Concrete shall be uniform and thoroughly mixed when delivered to job site. Maximum mixing and delivery time is 1.5 hours when air temperature is less than 85 deg F.
3. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated in the project plans, within tolerance limits of ACI 117. Forms must be adequately secured to prevent dislodging during concreting.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm), Class C, 1/2 inch (13 mm), Class D, 1 inch (25 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other

debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Items to be embedded in the concrete shall be positioned accurately and secured firmly. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
2. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated on project drawings or where approved by Contracting Officer.
2. No welding of either stress steel or temperature and shrinkage steel will be permitted without specific approval from Contracting Officer.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Reinforcement shall be bent and cut in accordance with CRSI and ACI Standard 315. Bars shall not be bent or straightened in a manner that will injure the material. Reinforcing steel shall not be heated to facilitate bending.

F. Rebar bends must have the following minimum inside diameters:

1. #3 bars = 2.25-inches
2. #4 bars = 3.00-inches
3. #5 bars = 3.75-inches
4. #6 bars = 4.50-inches
5. #7 bars = 5.25-inches

G. Rebar shall be placed as shown on the Drawings.

1. Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during placing of concrete.
2. The following tolerances will be allowed in the placement of reinforcing bars.

a. Where 1.5-inches clear distance is shown between reinforcing bars and forms, allowable

clear distance is 1.125-inches to 1.5-inches.

b. Where 2-inches clear distance is shown between reinforcing bars and forms, allowable clear distance is 1.625-inches to 2-inches.

c. Where 3-inches clear distance is shown between reinforcing bars and forms, allowable clear distance is 2.5-inches to 3-inches.

d. Maximum variation from indicated reinforcing bar spacing: 1/12th of indicated spacing, but no reduction in amount of bars specified.

H. Slab steel shall be supported by precast concrete bricks (not clay bricks), corrosion resistant metal chairs, or plastic chairs.

I. Concrete cover over reinforcing steel:

1. Unless otherwise indicated by the Drawings, reinforcing should be placed 1.5 to 2-inches from the top of slabs (centered in 4-inch slabs).
2. The ends of all stress or temperature and shrinkage bars shall be covered with at least 2-inches (50 mm) of concrete (e.g., top of walls).
3. Reinforcing must have a minimum of 3-inches of concrete cover where cast against earth (e.g., footings).

J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one grid. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete as shown on the project drawings.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved Contracting Officer.

1. Plan work so as to minimize construction joints (especially horizontal wall joints).
2. Place joints perpendicular to main reinforcement.
3. Do not continue reinforcement across construction joints unless otherwise indicated in the drawings. Extend wall vertical reinforcing through horizontal joints but do not extend horizontal reinforcing through vertical wall joints (except for round tanks which must have continuous laps and horizontal / hoop/ring reinforcement).
4. Install dowels across joints where indicated on the project drawings. Do not continue reinforcement through sides of strip placements of floors and slabs unless otherwise indicated in the drawings.
5. Form keyed joints as indicated. Embed keys into concrete at depths shown in the project drawings.
6. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
7. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
8. Space and locate vertical joints in walls as indicated in the drawings to match the slab joint locations. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible if visible.
9. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
10. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or

partially hardened concrete surfaces.

C. Contraction / Control Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints or wider to match joint sealant minimums into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Timing is important to control shrinkage cracking. Sawing is generally done in less than 24 hours of placement while the concrete is as green as possible.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Contracting Officer.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and the Contracting Officer's approval.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Where Self Consolidating Concrete is used, limit and/or avoid vibration to prevent mix segregation.
3. Deposit concrete as close as possible to its final position. It shall not be allowed to drop more than 5 feet (1.5 m) in forms and must not be required to flow laterally more than 8 feet (2.5 m).
4. If concrete must be dropped more than 5 feet (1.5 m), hoppers and chutes, “elephant trunks”, etc. shall be used to prevent segregation.
5. If concrete must be moved laterally more than 8 feet, it shall be moved by shoveling, chutes, conveyors, wheelbarrows, or similar equipment.
6. If a surface layer in place will develop its initial set before more concrete is placed on it, a construction joint shall be made.
7. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Where Self Consolidating Concrete is used, limit and/or avoid vibration to prevent mix segregation.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Slope surfaces uniformly to drains where required.
6. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Use of warm concrete with temperatures from 55 to 80 deg F.
3. Adequate protection from the weather, including the use of artificial heat, to prevent the temperature of the concrete from falling below 50 deg F for a period of three (3) days, and the relative humidity of the air near the concrete from falling below 40 percent.
4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 305 and as follows:

1. If concrete can not be maintained below 90 F, it shall not be mixed or placed.
2. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's

option.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
4. Cover concrete or otherwise keep moist for at least five days when temperatures are above 80 F.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one-part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one-part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

1. Walls should be free of rough concrete protrusions including those commonly found at form connections. All walls shall be plumb and free from bows and other defects. Level wall surface to a tolerance not exceeding ¼-inch in 10 feet.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or

darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces for non-slip surface, to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces manure storage and handling slabs, as shown on drawings, to receive trowel finish and /or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces as indicated on the drawings, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, epoxy or another thin-film-finish coating system.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces as indicated on the project drawings or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Contracting Officer before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases to the height shown on the project drawings and extend base than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days unless otherwise indicated on the project drawings.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install

dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

5. For supported equipment, install per manufacturer recommendations
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss [approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h)] before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover (e.g., polyethylene sheeting) for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound from surfaces that will have flooring or other materials bonded to the concrete surface without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 FORM REMOVAL

A. Forms shall not be removed until concrete has cured sufficiently which is typically about 24 hours during warm weather or for 48 hours during cold weather.

B. When forms are removed in less than seven (7) days, the concrete shall be sprayed with a curing compound and or be kept wet continuously by the methods allowed in this Specification.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi rigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Contracting Officer. Remove and replace concrete that cannot be repaired and patched to Contracting Officer’s approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Contracting Officer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Contracting Officer’s approval, using epoxy adhesive and patching mortar or other approved product.

F. Repair materials and installation not specified above may be used, subject to Contracting Officer’s approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Construction Observation: Contracting Officer will engage a qualified testing consultant to perform field tests, construction observation and prepare test reports. Testing personnel shall observe placing of all concrete and report non-conformance to the drawing and specifications to the Contracting Officer.

B. Construction Observation:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least two composite samples for each 5000 square feet or 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

    a. In accordance with ACI 237, where Self Consolidating Concrete (SCC) is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Contracting Officer and Ready Mix Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above section.
    b. In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be re-proportioned at the direction of Contracting Officer and Ready Mix Quality Control person.

4. Air Content: ASTM C 231 pressure method for normal-weight concrete: one test for each composite sample but no less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh/wet unit weight and dry/cured unit weight of structural concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite

sample.

b. Cast and field cure sets of two standard cylinder specimens for each composite sample if deemed necessary.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from the same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Contracting Officer, Concrete Manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests and wet and dry density tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and construction observation firm shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Contracting Officer. Testing firm may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Contracting Officer.
14. Additional testing and evaluation at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and construction checks indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 03 39 00 - CONCRETE CURING AND SEALING COMPOUND

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Application of clear, water-based acrylic curing and sealing compound on exposed interior slab-on-grade and exposed interior concrete stem wall surfaces at both greenhouse and headhouse spaces.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Concrete.

1.3 REFERENCES

A. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

B. ASTM C 1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

C. AASHTO M 148 - Liquid Membrane Forming Compounds for Curing Concrete.

D. USDA - United States Department of Agriculture.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean, dry area in accordance with manufacturer's instructions.

C. Keep product from freezing.

D. Avoid direct contact with product as it may cause mild-to-moderate irritation of the eyes and/or skin.

E. Protect materials during handling and application to prevent damage or contamination.

F. Do not mix any compound containing solvent.

G. Do not mix or agitate aggressively as foaming can occur.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply product when air, surface, or material temperatures are expected to fall below 40° F (4° C) within four hours of expected application.

B. Do not apply to frozen concrete.

C. Do not use on dense or porous surfaces.

1.7 WARRANTY AND MAINTENANCE

A. Furnish manufacturers standard warranty and maintenance data for project closeout documentation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Water-based acrylic curing and sealing compound shall be a non-yellowing, clear, acrylic curing and sealing compound meeting the following requirements:
1. ASTM C 309, Type 1, Class B
2. AASHTO M 148, Type 1, Class B
3. ASTM C 1315, Type 1, Class A
4. 30% solids minimum
5. VOC content less than or equal to 150 g/L

2.2 CONCRETE CURING AND SEALING COMPOUND

A. Manufacturers standard non-yellowing, clear, VOC compliant acrylic curing and sealing compound.
1. Manufacturers: Subject to compliance with requirements, provide one of the following products or comparable equal:
a. W. R. MEADOWS®, INC. - VOCOMP-30
b. Master Bulders Solutions – MasterKure CC 200WB
c. Dayton Superior – Cure&Seal 30% J23 WB (formerly Cure&Seal 1315 EF)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive curing and sealing compound. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

A. Protect adjacent surfaces not designated to receive curing and sealing compound.

B. Clean and prepare surfaces to receive curing and sealing compound in accordance with manufacturer's instructions.

C. Ensure concrete surface is clean and dry, with all stains, oil, grease, dust, and dirt removed.

D. Concrete surface water should be dissipated when used on new concrete.

D. Concrete surfaces should not be marred by walking workers.

3.3 APPLICATION

A. Apply curing and sealing compound in accordance with manufacturer's instructions. Allow product to cure before applying second coat at right angles to the first coat.

B. Ensure product is mixed for optimum performance. Avoid aggressive mixing as foaming may occur.

C. Use an industrial sprayer that produces a flow rate of 1/10 of one gallon per minute. Alternatively, apply using a lint-free roller or lamb's wool roller.

D. Avoid puddling in low areas.

3.4 PROTECTION

A. Drying time may vary by application rate, temperature, humidity, and project conditions. Restrict foot traffic for a minimum of four hours (for horizontal surfaces); 12 hours is preferable.

END OF SECTION

SECTION 03 42 13.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-110	(1984) Design Manual for Sulfide and Corrosion Prediction and Control
ACPA QPC	(202016) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A615/A615M	(2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A706/A706M	(2022) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2017) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884/A884M	(2019) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C857	(2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C858	(2010; E 2012) Standard Specification for Underground Precast Concrete Utility Structures
ASTM C877	(2021) Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C891	(2020) Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1244	(2020) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C1478	(2019) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
CSA GROUP (CSA)	
CSA A23.4	(2016; R 2021) Precast Concrete - Materials and Construction
NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)	

NPCA QC Manual (2017) Quality Control Manual for Precast and Prestressed Concrete Plants

1.2 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

SD-02 Shop Drawings

Standard Precast Units; G, AE
Custom-Made Precast Units; G, AE
Special Finishes

SD-03 Product Data

Standard Precast Units
Proprietary Precast Units
Embedded Items
Accessories

SD-05 Design Data

Design Calculations; G, AE
Concrete Mix Proportions

SD-06 Test Reports

Test Reports

SD-07 Certificates

Quality Control Procedures

SD-11 Closeout Submittals

Recycled content for fly ash and pozzolan; S Recycled content for Ground Iron Blast-Furnace Slag; S
Recycled content for Silica Fume; S Recycled content for Synthetic Fiber Reinforcement; S
Recycled content for steel; S

1.3 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual or ACPA QPC. Meet requirements written in the subparagraphs below.

1.3.1 NPCA and ACPA Plant Certification

The precast concrete producer must be certified by the National Precast Concrete Association's or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.3.2 Qualifications, Quality Control and Inspection

1.3.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer must maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.3.2.2 Quality Control Procedures

Submit quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and ACPA QPC. Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

1.3.2.2.1 Slump

Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C143/C143M.

1.3.2.2.2 Temperature

Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C1064/C1064M.

1.3.2.2.3 Compressive Strength

Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C31/C31M, ASTM C192/C192M, ASTM C39/C39M.

1.3.2.2.4 Air Content

Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C231/C231M or ASTM C173/C173M for normal weight aggregates and ASTM C173/C173M for lightweight aggregates.

1.3.2.2.5 Unit Weight

Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C138/C138M.

1.3.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.3.2.4 Test Reports

Submit the following:

1.3.2.4.1 Material Certifications or Laboratory Test Reports

Include mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

1.3.2.4.2 Mix Test

Submit reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

1.3.2.4.3 Self-Consolidating Concrete

Submit sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

1.3.2.4.4 In-Plant QA/QC Inspection Reports

Submit inspection reports upon the request of the Contracting Officer. 1.4 DELIVERY, STORAGE, AND

HANDLING

1.4.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.4.2 Storage

Store units off the ground or in a manner that minimizes potential damage.

1.4.3 Handling

Handle, transport, and store products in a manner to minimize damage.
Lifting devices or holes must be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least three years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades. Below grade structures must comply with ASTM C858.

2.1.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ASTM C478, ASTM C857, ACPA 01-102, Chapter 7-Design for Sulfide Control. Design must also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings. Submit drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings must demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings. Submit cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

2.1.2 Custom-Made Precast Units

Submit design calculations for custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices. Submit drawings furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

2.1.3 Proprietary Precast Units

Products manufactured under franchise arrangements must conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, must conform to the requirements in this specification. Submit standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

2.1.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

2.1.5 Concrete Mix Design

2.1.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project.

Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design and proportions for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

2.1.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of 4000 psi.

2.1.5.3 Water-to-Cement Ratio

Where exposed to freezing and thawing, furnish concrete containing entrained air and with a water-cementitious ratio of 0.45 or less. Where not exposed to freezing, but required to have a low permeability, furnish concrete with a water-cementitious ratio of 0.48 or less. Where exposed to deicer salts, brackish water, or seawater, furnish concrete with a water-cementitious ratio of 0.40 or less, for corrosion protection.

2.1.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions must be within the limits given below.

	AIR CONTENT PERCENT	
NOMINAL MAXIMUM AGGREGATE SIZE	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
3/8 inch	6.0	7.5
1/2 inch	5.5	7.0
3/4 inch	5.0	6.0
1.0 inch	4.5	6.0
1.5 inch	4.5	5.5
	AIR CONTENT PERCENT	
NOMINAL MAXIMUM AGGREGATE SIZE	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent		

2.1.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

2.2 MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING:

a. Recycled content for fly ash and pozzolan
b. Recycled content for Ground Iron Blast-Furnace Slag
c. Recycled content for Silica Fume
d. Recycled content for Synthetic Fiber Reinforcement
e. Recycled content for steel, 75 percent minimum

2.2.2 Pigments

Non-fading and lime-resistant

2.2.3 Reinforcement

2.2.3.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A615/A615M

b. Deformed Low-alloy steel: ASTM A706/A706M

2.2.3.2 Reinforcing Wire

a. Plain Wire: ASTM A1064/A1064M

b. Deformed Wire: ASTM A1064/A1064M

2.2.3.3 Welded Wire Reinforcement a. Plain Wire:

ASTM A1064/A1064M

b. Deformed Wire: ASTM A1064/A1064M

2.2.3.4 Epoxy Coated Reinforcement

a. Reinforcing Bars: ASTM A775/A775M

b. Wires and Welded Wire: ASTM A884/A884M

2.2.3.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A767/A767M.

2.2.4 Synthetic Fiber Reinforcement

Provide fiber reinforced concrete in accordance with ASTM C1116/C1116M Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be monofilament polypropylene fibers, with a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Toughness indices must meet requirements for performance level I.

2.2.5 Inserts and Embedded Metal

All items embedded in concrete must be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A36/A36M

b. Hot-dipped Galvanized: ASTM A153/A153M

c. Proprietary Items: In accordance with manufacturers published literature

2.2.6 Accessories

Submit proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C443.

b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: ASTM C877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C990.

d. Elastomeric Joint Sealants: ASTM C920

2.2.7 Pipe Entry Connectors

Pipe entry connectors must conform to ASTM C923 or ASTM C1478.

2.2.8 Grout

Nonshrink Grout must conform to ASTM C1107/C1107M. Cementitious grout must be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire reinforcement into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover must be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix at the batch plant in accordance with the applicable sections of ASTM C1116/C1116M and the recommendations of the manufacturer. Use a minimum of 1.5 pounds of fibers per cubic yard of concrete.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations must produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. All concrete materials, reinforcement, forms, fillers, and ground with which concrete is to come in contact must be free from frost.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing must not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Follow recommendations for hot weather concreting in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing must not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C171.

b. Cover with burlap or other absorptive material and keep continually moist.

c. Use a membrane-curing compound, conforming to ASTM C309 and applied at a rate not less than 200 square ft/gallon, or in accordance with manufacturers' recommendations.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete must not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted. Major imperfections, honeycombs, or other major defects are not permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes must be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes must be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least five days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.

b. Lift products by suitable lifting devices at points provided by the precast concrete producer.

c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use the following method:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to ASTM C1244.

-- End of Section --

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

1. Masonry-joint reinforcement.
2. Miscellaneous masonry accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Steel lintels and steel shelf angles in accordance with Section 055000 "Metal Fabrications" in concrete unit masonry.

C. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

C. Exposed: Weather-exposed side of a constructed wall.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315
3. Lintel design and types required.
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.
b. For masonry units, include data and calculations establishing average net-area

compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 402/602.

E. Weather Procedures:

1. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
2. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Project team craftworkers of the Masonry Contractor assigned to Project will be required to have the International Masonry Institute - Flashing Training or equal and to provide evidence of certificate or a letter of the firm's commitment to enroll key project personnel in the training program prior to the start of Project.

B. Project team craftworkers of the Masonry Contractor assigned to Project will be required to have the International Masonry Institute - Grouting and Reinforcing Training or equal and to provide evidence of certificate or a letter of the firm's commitment to enroll key project personnel in the training program prior to the start of Project.

C. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination

avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with Tables 1 and 2 in TMS 402/602.
2. Determine net-area compressive strength of masonry by testing masonry prisms accordance with ASTM C1314.

B. Regulatory Requirements: Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified:

1. TMS 402/602:

a. Maintain one copy of the standard in Project field office at all times during construction. Contractor's supervisory personnel are to be thoroughly familiar with this material as it applies to Project.

2.3 CONCRETE UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 402/602 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

D. Concrete Building Brick: ASTM C55.

1. Density Classification: Normal weight.

E. Building Lintels:

1. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout.

F. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing in accordance with ASTM E119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Standard CMUs: Load-bearing ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as specified in the drawings,
2. Density Classification: Normal weight, unless otherwise indicated in drawings.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Contracting Officer's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

E. Aggregate for Grout: ASTM C404.

F. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Contracting Officer from manufacturer's colors.

G. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch or 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch or 0.187-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M commercial steel, with ASTM A153/A153M, Class B coating.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- or 0.25-inch- diameter, hot-dip galvanized steel wire.

D. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Rust-inhibitive paint.

2.8 EMBEDDED FLASHING MATERIALS

A. Embedded Flashing Applications: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use one of the following:

   a. Metal flashing with a drip edge or with a sealant stop
   b. Flexible flashing with a metal drip edge
   c. Elastomeric thermoplastic flashing with a drip edge
   d. Flexible flashing with a metal sealant stop.

4. Where flashing is fully concealed, use metal flashing or flexible flashing.

B. Flexible Flashing:

1. Flexible Flashing Fabrication:

a. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
b. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
c. Fabricate metal expansion-joint strips from stainless steel or copper to shapes indicated.
d. Solder metal items at corners.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
2. Solder for Copper: ASTM B32,Grade Sn50.
3. Elastomeric Sealant: ASTM C920, chemically curing urethane,polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene. urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MASONRY-CELL INSULATION

A. Masonry-Cell Fill: Loose-fill insulation, perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Molded-Polystyrene Insulation Units: CMU units with molded rigid expandable polystyrene-inserts to comply with ASTM C578, Type 1. Provide insulated block units designed for installing in cores of masonry units.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N or Type S.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 402/602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Exposed Masonry: Mix units to produce uniform blend of colors and textures.

E. Where existing masonry occurs, match coursing, bonding, color, and texture of existing masonry.

F. Temperature Control: Perform temperature-sensitive construction procedures while masonry Work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 deg F.

1. 40 to 32 Deg F (4 to 0 Deg C):

   a. Mortar: Heat mixing water to produce mortar temperature between 40 and 120 deg F.
   b. Grout: Follow normal masonry procedures.

2. 32 to 25 Deg F (0 to Minus 4 Deg C):

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F; maintain temperature of mortar on boards above freezing.
   b. Grout: Heat grout materials to 90 deg F to produce in-place grout temperature of 70 deg F at end of workday.

3. 25 to 20 Deg F (Minus 4 to 7 Deg C):

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F; maintain temperature of mortar on boards above freezing.
   b. Grout: Heat grout materials to 90 deg F to produce in-place grout temperature of 70 deg F at end of workday.
   c. Heat both sides of walls under construction using salamanders or other heat sources.
   d. Use windbreaks or enclosures when wind is in excess of 15 mph.

4. 20 Deg F (Minus 7 Deg C) and Below:

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F.
   b. Grout: Heat grout materials to 90 deg F to produce in-place grout temperature of 70 deg F at end of workday.
   c. Masonry Units: Heat masonry units so that they are above 20 deg F at time of laying.
   d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 deg F for 24 hours after laying units.

5. Do not heat water for mortar and grout to above 160 deg F.

G. Masonry Protection: Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry.

For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.

1. 40 to 32 Deg F (4 to 0 Deg C): Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
2. 32 to 25 Deg F (0 to Minus 4 Deg C): Completely cover masonry with weather-resistive membrane for at least 24 hours.
3. 25 to 20 Deg F (Minus 4 to 7 Deg C): Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
4. 20 Deg F (Minus 7 Deg C) and Below: Except as otherwise indicated, maintain masonry temperature above 32 deg F (0 deg C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry, maintain heated enclosure to 40 deg F for 48 hours.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Penetration Firestopping."
5. Joint Sealants: Comply with ASTM C1193 for use of joint sealants, including acoustic sealants as applicable to materials, applications and Project conditions.
6. Penetration Firestopping: Install penetration firestopping systems for Project applications to comply with manufacturer's written installation instructions.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.

3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Where applicable, set masonry trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-CELL FILL INSTALLATION

A. Pour insulation materials into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 ft..

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.7 CONTROL JOINTS

A. General: Install control joint materials in CMUs as masonry progresses. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement.

1. Exception: Reinforcement in bond beams at roof bearing level shall be provided continuous through control joint locations.

B. Locate control joints. See Drawings, maximum 25 feet.

C. Form control joints in CMUs as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.8 LINTELS

A. Install lintels over openings as indicated.

B. Provide concrete or formed-in-place masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

C. Install loose steel over openings: See Drawings.

1. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

D. Lintels at Fire-Rated Openings: Provide fire-rated masonry required or steel lintels with applied fireproofing in thickness required to maintain fire rating of wall or partition rating.

3.9 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.10 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced

masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 402/602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 402/602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contracting Officer will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.

B. Inspections: Level 1 special inspections to comply with the International Building Code.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces, grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.

J. Fire-Resistance Rated Construction: Where applicable, inspect fire-rated CMU construction to determine compliance with construction documents per building code compliance.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as Work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Contracting Officer's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid-strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 08-04A.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off property.

END OF SECTION 04 22 00

SECTION 05 05 20 - POST-INSTALLED CONCRETE AND MASONRY ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-installed anchors for concrete and concrete masonry substrates.
2. Mechanical anchors (expansion, screw, or undercut types).
3. Adhesive anchors (epoxy, hybrid, or acrylic-based systems).
4. Testing, inspection, and quality control for anchor installations.

B. Related Sections:

1. 03 30 00 - Cast-in-Place Concrete
2. 04 22 00 – Concrete Unit Masonry

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
2. ACI 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary

B. ASTM International:

1. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars
2. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete and Masonry

C. International Code Council (ICC):

1. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete
2. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors

1.3 DEFINITIONS

A. Periodic Special Inspection: Inspections per this specification, performed by a qualified inspector.

1.4 SUBMITTALS

A. Product Data:

1. Manufacturer’s technical data sheets and ICC-ES Evaluation Reports for each anchor type.
2. Certified test reports showing compliance with ACI 355.2 or ACI 355.4.
3. Manufacturer’s printed installation instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Certified by ACI/CRSI Adhesive Anchor Installer program or equivalent manufacturer training.
2. Training within 3 years, covering hole drilling, cleaning, adhesive injection, and anchor installation.
3. Submit certifications including organization, instructor qualifications, trainee details, and performance test confirmation.

B. Post-Installed Anchor Special Inspector Qualifications:

1. Minimum 2 year of experience as a Special Inspector on similar projects.
2. Submit resumes and training records.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver anchors in manufacturer's original, undamaged packaging with installation instructions.

B. Store in a dry, climate-controlled environment per manufacturer's recommendations, preventing freezing or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mechanical Anchors:

1. Types: Expansion, screw, or undercut anchors.
2. Material: Galvanized carbon steel per ASTM A153/A153M or stainless steel per ASTM A193/A193M.
3. Compliance: ACI 355.2 and ICC-ES AC193, tested for cracked and uncracked concrete.

B. Adhesive Anchors:

1. Types: Moisture-insensitive epoxy, hybrid, or acrylic-based systems.
2. Material: Two-component adhesive, suitable for cracked and uncracked concrete.
3. Threaded Rods: ASTM F1554 Grade 36, galvanized per ASTM A153/A153M.
4. Compliance: ACI 355.4 and ICC-ES AC308

2.2 EQUIPMENT

A. Provide dependable drilling equipment and carbide-tipped bits suitable for concrete and masonry.

B. Maintain equipment in good working condition per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrate conditions (concrete strength, masonry type, age) meet anchor requirements.

B. Report unsatisfactory conditions to the Contracting Officer before proceeding.

3.2 INSTALLATION

A. General:

1. Install anchors per manufacturer's instructions, ICC-ES reports, and project drawings.
2. Use templates to ensure accurate anchor placement and alignment.

B. Mechanical Anchors:

1. Drill holes perpendicular to surface (max 6° deviation) using specified diameter and depth.
2. Clean holes (blow, brush, blow) per manufacturer's requirements.
3. Install anchors using torque-controlled tools to specified values.
4. Protect threads and ensure proper embedment.

C. Adhesive Anchors:

1. Drill and clean holes per manufacturer's requirements, ensuring dust-free conditions.
2. Inject adhesive using dispensing tools, filling hole from bottom up.
3. Insert rods or bars with slow rotation to eliminate air voids.
4. Secure anchors during curing period for horizontal or overhead installations.
5. Allow adhesive to cure per manufacturer's recommended time before loading.

3.3 FIELD QUALITY CONTROL

A. Mechanical Anchors:

1. Periodic special inspections per ICC IBC and ICC-ES Evaluation Report.
2. Verify anchor type, dimensions, hole cleaning, spacing, edge distances, and torque.
3. Torque test (for torque-dependent anchors):

   a. First 3 anchors of each type/size per installer.
   b. Minimum 5% of randomly selected anchors using a calibrated torque wrench.

4. Proof load test (for non-torque-dependent anchors):

   a. First 3 anchors of each type/size per installer.
   b. Minimum 5% of randomly selected anchors per ASTM E488/E488M.

5. Proof load: Minimum of value on drawings or 50% of tension capacity.
6. Failure: Displacement > 0.1 inch D/10 or ASTM E488/E488M failure modes.

B. Adhesive Anchors:

1. Periodic special inspections per ICC IBC and ICC-ES Evaluation Report.
2. Verify anchor type, dimensions, hole cleaning, adhesive mixing, and curing procedures.
3. Proof load test:

   a. First 3 anchors of each type/size per installer.
   b. Minimum 5% of randomly selected anchors per ASTM E488/E488M.

4. Proof load: Minimum of value on drawings or 50% of tension capacity.
5. Failure: Displacement > 0.1 inch D/10 or ASTM E488/E488M failure modes.
6. Do not torque test adhesive anchors.

C. Action for Failed Tests:

1. Report failed anchors to Contracting Officer immediately.
2. Test 2 adjacent anchors for each failed anchor.
3. Continuously inspect and test replacement anchors.
4. Fill unused or failed anchor holes with non-shrink, non-metallic grout approved by the Contracting Officer.

D. Post-Installed Anchor Special Inspections Report:

1. Submit bi-weekly as a PDF to the Contracting Officer.
2. Include:

a. Locations of inspected/tested anchors.
b. Inspector's name and inspection dates.
c. Summary of work completed.
d. Test results and acceptance/rejection statement.
e. Confirmation of compliance with contract documents and manufacturer's instructions.

3.4 PROTECTION

A. Protect installed anchors from damage during construction.

B. Remove and replace damaged or misaligned anchors per Contracting Officer's approval.

END OF SECTION 05 05 20

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

1. Primers.
2. Steel joist accessories.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry" for installing bearing plates in unit masonry.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

C. Delegated Design Submittals: For steel joist framing, including analysis data signed and sealed by the qualified structural engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Mill Certificates: For each type of bolt.

D. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

E. Field quality control reports.

F. Qualification Statements: For manufacturer and Erector.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications.

B. Erector Qualifications: An experienced Erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Delegated Design Engineer Qualifications: A structural engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

D. Welding Qualifications: Qualify field-welding procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications.

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

A. Deliver steel bearing plates to be built into masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural engineer to design steel joist framing.

B. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

1. Design special joists to withstand design loads with live-load deflections no greater than the following:

a. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Provide shop primer that complies with Section 099123 "Interior Painting.

2.3 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
2. Detail and fabricate in accordance with SJI's "Specifications. Furnish additional erection bridging if required for stability.
3. Fabricate as indicated on Drawings and in accordance with SJI's "Specifications. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. Shop prime paint.

C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
2. Finish: Plain, uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

E. Welding Electrodes: Comply with AWS standards.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.4 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

D. Shop priming of joists and joist accessories is specified in Section 099123 "Interior Painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 REPAIRS

A. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, butting structural steel, and accessories.

    a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
    b. Apply a compatible primer of same type as primer used on adjacent surfaces.

2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds in accordance with AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.

2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch or 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A780/A780M.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.3 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on top surface of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099123 "Interior Painting."
4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall studs.
2. Roof Rafters.
3. Bracing.
4. Box Headers

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers printed technical data indicating products provided that comply with requirements of drawings

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATION SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Evaluation Reports: For cold-formed steel framing and accessories

1. Products to be certified under an independent qualified third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 Accreditation Criteria for Inspection Agencies.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).

B. Provide certification of code compliance with the “Code Compliance Certification Program” implemented by the Steel Framing Industry Association (SFIA).

C. Product Tests: Mill certificates or data from a qualified independent testing agency or in-house testing with

calibrated test equipment, indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness. Manufacturer inclusion in the “SFIA Code Compliance Certification Program: meets this requirement.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: Comply with AISI S240, CP60.

2.2 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, required by design requirements.

2.3 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.4 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing wall panels and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
3. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
4. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 FIELD QUALITY CONTROL

A. Testing: Contracting Officer will engage a qualified independent testing and inspecting agency to perform

field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contracting Officer.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 04 22 00 – Concrete Unit Masonry

C. Section 05 21 00 - Steel Joist Framing

D. Section 05 31 00 - Steel Decking

E. Section 07 71 00 - Roof Specialties

F. Section 09 91 23 - Interior Painting

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for countertops.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Metal ladders.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 04 22 00 "Concrete Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.3 REFERENCES

A. Steel Construction Manual: American Institute of Steel Construction (AISC).

B. American Welding Society (AWS).

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.3 – Structural Welding Code – Sheet Steel.
3. AWS D1.2 – Structural Welding Code – Aluminum.

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

1. ASTM A36 - Structural Steel.
2. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
3. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A283 – Low and Intermediate Tensile Strength Carbon Steel Plates.
6. ASTM A307 - Carbon Steel Bolts and Studs Externally and Internally Threaded Fasteners, 60,000 PSI Tensile Strength.
7. ASTM A325 – Structural Bolts, Steel, Heat Strengthened, 120/105 KSI Minimum Tensile Strength.
8. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. ASTM A510 - General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
11. ASTM A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
12. ASTM A570 - Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
13. ASTM A611 - Steel Sheet, Carbon, Cold-Rolled, Structural Quality.
14. ASTM A780 - Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
15. ASTM A48 - Gray Iron Castings.
16. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B308 – Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. ASTM B429 – Aluminum-Alloy Extruded Structural Pipe and Tube.

D. American National Standards Institute (ANSI)

1. ANSI A14.3 - Safety Requirements for Fixed Ladders
2. ANSI Z49.1 – Safety in Welding, Cutting and Allied Processes

E. National Association of Governmentural Metal Manufacturers, (NAAMM).

F. Society for Protective Coatings (SSPC)

1. SSPC-SP1 - Solvent Cleaning
2. SSPC-SP2 - Hand Tool Cleaning
3. SSPC-SP3 - Power Tool Cleaning
4. SSPC-SP6 - Commercial Blast Cleaning
5. SSPC-SP11 - Power Tool Cleaning to Bare Metal

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Ladders
   2. Paint products.
   3. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
   1. Steel framing and supports for operable partitions.
   2. Steel framing and supports for countertops.
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   5. Metal ladders.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainability:
   1. For each distinct product contributing towards any of the LEED v4,1 Building Product Disclosure and Optimization (BPDO) credit, provide supporting documentation per 01 33 29 LEED Sustainable Design.
   2. For all interior products under applicable product categories as defined by LEEDv4.1 credit low-emitting materials, provide supporting documentation per 01 33 29 LEED Sustainable Design and 01 61 16 LEED Volatile Organic Compound

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304, A300 series.

E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304, A300 series

F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

I. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

J. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

L. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type A300 series stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 Interior Painting.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate supports for operable partitions from continuous steel beams of sizes as indicated and recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3

B. Steel Ladders:

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch-diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) IKG.
      2) Ross Technology Corporation.
      3) W.S. Molnar Company.
6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
7. Galvanize and prime ladders, including brackets.
8. Prime ladders, including brackets and fasteners, with zinc-rich primer.
9. Coordinate installation with roof hatch per Section 07 72 00 Roof Accessories.

C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

   1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.9 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in “Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Fire-retardant-treated lumber (for use at Utility Chaseway – coordinate with Code Plan).
3. Plywood backing panels (fire-retardant-treated at Utility Chaseway).

1.2 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

1.3 ACTION SUBMITTALS

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use Category UC2 for interior construction not in contact with ground. Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841. For enclosed roof framing, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
3. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Dimension Lumber Items: No. 2 grade lumber, Mixed southern pine or southern pine; SPIB.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated**,** in thickness indicated or, if not indicated, not less than **3/4-inch (19-mm)** nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of with hot-dip zinc coating complying with ASTM A153/A153M or Type 304 stainless steel.

B. Screws for Fastening to Metal Framing: ASTM C1002 length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).

G. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION 06 10 00

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 WORK INCLUDES:

A. General Contractor shall provide all labor, materials, equipment, and services necessary or incidental to the completion of all work of this section as shown on the drawings, herein specified, or otherwise required.
   a. Cold-applied, emulsified-asphalt dampproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course, auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products are to comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Acceptable Manufacturers:
   1. W.R. Meadows
   2. Henry (A Carlisle company)
   3. Sika
   4. Tremco

B. Trowel Coats: ASTM D1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.

D. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

E. ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch (3 mm).
2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel acceptable to dampproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core, with or without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 INSTALLATION OF COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations and Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat.

3.5 INSTALLATION OF PROTECTION COURSE

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
2. Install protection course on same day of dampproofing installation (while coating is tacky) to ensure adhesion.

3.6 INSTALLATION OF DRAINAGE PANEL

A. Molded-Sheet Drainage Panels: Install panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 PROTECTION

A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 07 11 13

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Perimeter and under slab insulation.

B. Spray foam insulation for exterior door frames.

C. Semi rigid mineral wool insulation in rainscreen applications.

1.2 RELATED DOCUMENTS

A. Cold Formed Metal Framing Section 05 40 00

B. Rough Carpentry Section 06 10 00

C. Fluid-Applied Membrane Air Barrier: Section 07 27 26

D. Thermoplastic-Polyolefin (TPO) Roofing: Section 07 54 23

E. Penetration Firestopping: Section 07 84 13

1.3 REFERENCES

A. Standards

1. American Society for Testing and Materials (ASTM)
   a. ASTM C578 Preformed, Cellular Polystyrene Thermal Insulation.
   b. ASTM C665 Mineral-fiber Blanket Thermal Insulation for Light Frame Construction.
   c. ASTM C612 Specification for Miner Fiber Block and Board Thermal Insulation.

1.4 ACTION SUBMITTALS

A. Shop Drawings and Product Data: For each type of product.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Store insulation materials at the site storage trailers or the building in a dry, ventilated place. Exterior storage not permitted. Comply with manufacturer's recommendations for handing and protection during installation.

C. Remove fibrous batt insulation that has become wet before or after installation. Replace with new, dry insulation.

D. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.6 QUALITY ASSURANCE

A. Insulation Thermal Properties: Thermal conductivity k-factors and thermal resistance R-values are values at 75 degrees F., mean temperature.

1. Where insulation is identified by R-value, provide thickness required to achieve indicated R-value. Foam Insulation R-values are "aged" thermal values in accordance with PIMA Bulletin #101 and RIC/TIMA Bulletin #281-1 conditioning procedures.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type IV, Drainage Panels ASTM C 578, Type IV, 60-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels and geo-filtration fabric.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Chemical Company (The).
b. Owens Corning.

2.2 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced. ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Rockwool International.
   c. Thermafiber, Inc.; an Owens Corning company.

2.3 SPRAY FOAM INSULATION

A. CLOSED-CELL SPRAY POLYURETHANE FOAM
1. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C).

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following medium density, closed cell spray polyurethane foam insulation:
   a. Carlisle Spray Foam Insulation, Sealtite Pro
   b. Accufoam CC-HFO
   c. Johns Manville JM Corbond® III
3. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Where foam product does not meet ASTM E84 or NFPA 285 a manufacturer approved thermal barrier is to be applied over exposed spray cell foam.
   a. Thermal and Ignition Barriers shall be manufacturer approved.
6. Thickness:
   a. As indicated or as required to fill voids where applicable.
   b. 2” minimum thickness at interior of exterior stud walls.
   c. Full stud width at parapet where indicated on drawings.

2.4 LOW PRESSURE LOW EXPANSION WINDOW AND DOOR FOAM – for cracks and spaces around window jambs:

A. Available Manufacturers:
1. Dow Chemical, Great Stuff Pro Window & Door Insulating Foam
2. Hilti, CF 812 Window & Door Pro Low Pressure Filler Foam
3. DuPont, Window & Door Foam
4. Surface-Burning Characteristics: Comply with UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less

2.5 SEMI REGID MINERAL-WOOL INSULATION

A. Description: Non-combustible, semi-rigid mineral wool insulation board that is water repellent and resist temperatures above 2,000 degrees F, Types IVB, Unfaced. ASTM C 612.

1. Thickness as indicated on the drawings.
2. R-value: 4.2 per inch
3. Facing: unfaced
4. Density:
   a. Outer Layer: 6.2 pcf
   b. Inner Layer: 3.4 pcf
5. Surface Characteristics per ASTM E84:
   a. Flame Spread: 0
   b. Smoked Developed: 0
6. Moisture Resistance: Absorbs less than 0.03% by volume, ASTM C1104.
7. Non-corrosive: ASTM C665
8. Fiber Color: Darkened color at rainscreen applications.
9. Manufacturers: Basis of Design is Roxul CavityRock. Subject to compliance with requirements, provide products by one of the following:
   a. Rockwool International- ROXUL CavityRock.
   b. Thermafiber, Inc.; an Owens Corning company – THERMAFIBER Rainbarrier Continuous Insulation.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGM Industries, Inc.
   b. Gemco.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Composite Framing Support Clips (CFS) - Thermal Insulation Spacers: Are to be coordinated with section 07 42 46 High Density Cementitious Wall Panels. Design of the support system is to be a delegated design which includes performance design requirements outlined in section 07 42 46 High Density Cementitious Wall Panels in addition to this section. System comprised of fiberglass or FRP standoff spacers and galvanized steel Z-girts. Composite Framing Support Clips are to be coordinated with section

1. Depth: As indicated. Coordinate with thickness of insulation.
2. Steel Z-girts plate inserts: 18 gauge, Galvalume AZM 150 Coating 1.5” x 1” x1.25”
3. Fasteners: Type and size as recommended by spacing manufacturer.
4. Spacing: Continuous girts 16” o.c. horizontally tied to metal framing
5. Approved manufacturers:
   a. Basis of Design: EcoCladding Sigma VCI.40 System
   b. SMARTci GreenGirt Clips Composite Framing (CFS) System
   c. Cascadia Clips by CASCADIA Windows

2.7 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

B. Examine substrates and installation conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected.

C. Verify substrate surfaces are dry and free of irregularities or substances harmful to insulation. Remove projections that interfere with insulation placement.

D. Verify mechanical and electrical services within walls have been installed and tested.

E. Fill miscellaneous voids and spaces in wall framing and at window and door framing with batt insulation loosely stuffed in place.

F. Spray-On and Spray Foam Insulations: Provide masking, drop cloths or other satisfactory coverings for all materials/ surfaces which are not to receive insulation.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SEMI-RIGID INSULATION

A. Place insulation horizontally within cavity between high density cementitious wall panels and concrete block or metal stud/sheathing substrate. Place on exterior surface of substrate.

B. Coordinate insulation placement with installation of thermal insulation spacers. Place to ensure tight joints between all insulation panels installed and between insulation panels and adjacent materials.

3.4 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.5 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

D. Provide geotextile filter fabric with drainage cores as protection course at foundation wall insulation. Basis of Design: W.R. Meadows Mel-Drain. Install per manufacturer’s instructions.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.7 SPRAY FOAM INSULATION

A. Prepare surfaces as recommended by insulation manufacturer. Remove substances from metal deck or other metal surfaces that will prohibit insulation/metal bond. Apply primer where required by manufacturer.

B. Install as recommended by manufacturer. Install in areas where indicated on the drawings. Fill all voids for a complete solid installation.

C. Provide manufacturer’s recommended fire-rated barrier at exposed conditions.

D. Clean-up all overspray from adjacent surfaces and floor.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 27 26 – FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fluid-applied membrane air barriers:
   a. Fluid-applied, vapor-permeable, air and water resistive membrane applied onsite to exterior, exposed side of the headhouse walls (concrete masonry units) and utility chaseway walls (glass mat gypsum sheathing).

B. Related Requirements:

1. Section 04 22 00 “Unit Masonry”
2. Section 07 62 00 “Sheet Metal Flashing”
3. Section 07 92 00 “Joint Sealants”
4. Section 09 29 00 “Gypsum Board Systems”

1.3 REFERENCES

A. Definitions:

1. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
2. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
3. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

B. Reference Standards:

1. The date of the standard is that in effect as the date of receipt of the bids for the project.
2. ASTM International (ASTM).
3. International Code Council (ICC).
4. National Fire Protection Association (NFPA).

1.4 ADMINSTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct conference at PROJECT SITE.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

D. Sustainability:

1. For each distinct product contributing towards any of the LEED v4.1 Building Product Disclosure and Optimization (BPDO) credits, provide supporting documentation per 01 33 29 LEED Sustainable Design.
2. For all interior products under applicable product categories as defined by LEED v4.1 credit Low-Emitting Materials. Provide supporting documentation per 01 33 29 LEED Sustainable Design and 01 61 16 LEED Volatile Organic Compound.

1.6 INFORMATIONAL SUBMITTALS

B. Qualification Data: Installer trained by the manufacturer of fluid-applied air barriers for system installation.

B. Product Certificates: From air barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: NFPA 285 tested assembly for each air-barrier assembly, tests performed by a qualified testing agency

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be trained by the manufacturer in the installation of the fluid-applied air barrier system. Installer will maintain trained installers and supervisors on site for the duration of the project.

B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.

1. Build integrated mockups of exterior wall assembly**.** Coordination size with description of mock-up and components outlined in specification section, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
   a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing membrane, building corner condition,] [and] [foundation wall intersection.
   c. If Government determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Government specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
4. Mock-ups maybe integrated into the final wall assembly upon Government's approval.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 2357.
3. Adhesion Testing: Mockups will be tested for required air-barrier and accessory material adhesion to substrate according to ASTM D 4541.
4. Notify Government seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packaging and store in an enclosed shelter providing protection from damage and exposure to the elements.

1. Store within temperature limits required by manufacturer.
2. Comply with manufacturer's requirements for safety and handling.

B. Discard liquid sealants and adhesives that cannot be applied within their stated shelf life.

C. Store accessory materials in a location with constant ambient temperatures of 40 to 110 degrees Fahrenheit (15 to 27 degrees Celsius).

1.10 FIELD CONDITIONS

A. Cold Weather Conditions:

1. Fluid-Applied Air and Water Barrier: Comply with manufacturer's cold weather application instructions when atmospheric temperatures or substrate surface temperatures are less than 40 degrees Fahrenheit (4 degrees Celsius).
2. Accessories and Sealants: Comply with manufacturer’s cold weather application instructions when atmospheric temperatures or substrate surface temperatures are less than 40 degrees Fahrenheit (4 degrees Celsius).
3. Do not apply fluid-applied air and water barrier accessories to a damp or wet substrate or during snow, rain, fog, or mist.

B. Exposure: Comply with manufacturer’s limitations on exposure of applied product.

1. Protect adjacent substrates from environmental conditions that affect air barrier performance.

C. Coordinate installation of fluid-applied air and water barrier assembly with completion of roofing, below grade, and other work requiring interface with air barrier.

D. Schedule work for inspection of fluid-applied air and water barrier assembly applications prior to concealment.

E. Ensure fluid-applied air and water barrier accessories are cured before covering with other materials.

1.11 WARRANTY

A. Manufacturer's Warranty for Fluid-Applied Air and Water Barrier & Accessory Products: Manufacturer’s standard form in which manufacturer agrees to, at its option, replace each nonconforming product or refund the purchase price of the quantity of product shown to be nonconforming.

1. Manufacturer is not responsible for loss resulting from warranty-excluded limitations, outlined deterioration, or failure of air-barrier materials from the following:
   a. Movement of the structure caused by structural settlement or stresses on the air and water barrier exceeding manufacturer's written specifications for elongation.
   b. Mechanical damage caused by others.
2. Access for Repair: Manufacturer to be provided with unimpeded post-occupancy access to the project facility and air-barrier system for purposes of testing, leak investigation, and repair.
3. Warranty Period for Fluid-Applied Air and Water Barrier Products: Five years from date of Substantial Completion.

B. Air and Water Barrier Warranty: Provide manufacturer's warranty that when at least one component from each of the categories of components constituting manufacturer's system is applied to an above-grade concrete block or poured concrete or to a metal stud and sheathing wall assembly to prevent air and water vapor from penetrating the building walls and entering the interior of the building for a period of five years beginning on the date of Substantial Completion.

C. Air and Water Barrier Accessories Warranty: Provide accessory manufacturer's warranty for period of five years beginning on the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed dampproofing, waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum [0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa)] Pass, when tested according to ASTM E 2357.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Medium Build, Vapor-Permeable Fluid-Applied Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 15 to 35 mils (0.38 to 0.9 mm) over smooth, void-free substrates.

1. Fluid-Applied Medium-Build, Vapor-Permeable Air Barrier
   a. Basis of Design Product: Tremco Incorporated Exoair 230
   b. Prosoco R-Guard Cat 5 Rain Screen
   c. W.R. Meadows Air-Sheild TMP

2. Physical and Performance:
   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) 8 perms pressure difference; ASTM E 2178.
   b. Vapor Permeance: Minimum 5 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M, Desiccant Method, Procedure A.
   c. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.1 AIR-BARRIER ACCESSORY MATERIALS

A. General: Provide compatible air-barrier accessory materials furnished or recommended by fluid-applied air and water barrier manufacturer as required by Project conditions to produce a complete air-barrier assembly identical to tested assemblies meeting performance requirements.

B. Primer: Liquid primer recommended by air-barrier manufacturer for substrates requiring field application of air-barrier materials.

C. High- and Low-Temperature Flashing and Transition Membrane: Self-adhering strip 22 mils (0.61 mm) thick, consisting of butyl laminated to an aluminized facer with a release liner.

1. Basis-of-Design Product: Tremco, Inc., ExoAir 110AT.

D. Wall Opening Transition Assembly: Cured low-modulus extruded silicone sheet, with reinforcing ribs, sized to fit opening widths, with aluminum race configured for insertion into aluminum framing extrusions, compatible with specified silicone joint sealant and fluid-applied membrane air-barrier.

1. Basis-of-Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly.

E. Wall Opening Transition Sheet: Cured low-modulus extruded silicone sheet, compatible with specified silicone sealant and fluid-applied membrane air-barrier.

1. Basis-of-Design Product: Tremco, Inc., Proglaze ETA Connections Single-Ribbed Sheet.

F. Reinforcing Mesh: Self-adhering fiberglass mesh, not less than 6 inches (152 mm) wide.

1. Basis-of-Design Product: Tremco 211 Mesh.

G. Joint Sealant for Exposed Air-Barrier Components: Single-Component, Nonsag, Non-Staining, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, Use NT; SWRI validated.

1. Basis-of-Design Product: Tremco, Inc., Spectrum 1.
2. Volatile Organic Compound (VOC) Content: 1 g/L or less.
3. Volatile Organic Emissions (VOE): GREENGUARD certified, it has met the world's most difficult and complete standards for low emissions of VOC's into indoor air.
4. Adheres to California Department of Public Health (CDPH) Standard Method V1.1-2010.

H. Joint Sealant for Exposed or Concealed Air-Barrier Components: Single-Component, Nonsag, Moisture-Cure, Polyurethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, Use NT; SWRI validated.

1. Basis-of-Design Product: Tremco, Inc., Dymonic 100.
2. Volatile Organic Compound (VOC) Content: 40 g/L or less.
3. Volatile Organic Emissions (VOE): GREENGUARD certified, it has met the world's most difficult and complete standards for low emissions of VOC's into indoor air.
4. Adheres to California Department of Public Health (CDPH) Standard Method V1.1-2010.

I. Preformed Silicone seal: For transitions between curtain wall and exterior opaque wall, parapets and curtain wall systems. Manufacturer's standard seal consisting of precured low-modulus silicone extrusion, in sizes to fit applications indicated on Drawings, combined with a neutral-curing liquid silicone sealant for bonding seals to substrates.
1. Basis of Design Product: Tremco, Inc.; Spectrem 1
2. DOW Corning 123 Silicone Seal System

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous.

F. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. General: Install transition strips, and accessory materials according to fluid-applied air and water barrier manufacturer's written instructions. Install strips and transition strips to form, connect, and seal membrane air-barrier material to adjacent components of building air-barrier system, including, but not limited to, roofing system air-barrier, exterior fenestration systems, door framing, and other openings.

B. Sealants: Apply sealants in accordance with manufacturer’s installation instructions on a per-assembly basis.

C. Seal punctures, voids, and seams. Patch with membrane strips extending 6 inches (150 mm) beyond repaired areas.

D. Connect and seal exterior wall air-barrier membrane continuously to subsequently installed roofing-membrane air-barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

E. Wall Openings Transition Assembly Installation: Apply opening transition assembly so that a minimum of 3 inches (75 mm) of coverage is achieved over fluid-applied air and water barrier.

F. Rough Openings: Treat rough openings with sealant or accessory products according to manufacturer installation instructions.

G. Flashings: Seal top of through-wall flashings to fluid-applied air barrier air and water barrier with continuous transition strips of type recommended by sheet air barrier manufacturer for type of flashing.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.

1. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements and photo documentation of conditions to be concealed by subsequent Work.

B. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Test air-barrier assemblies for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization or ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Quantitative Air-Leakage Testing: Test air-barrier assemblies for air leakage according to ASTM E 783.
3. Testing: Refer to Section 01 91 13 “General Commissioning Requirements” for additional testing and inspection requirements.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.

B. Clean spills, stains, and overspray resulting from application, utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.

C. Protect fluid-applied air and water barrier from damage from subsequent work. Protect membrane materials from exposure to UV light for period in excess of that acceptable to membrane air-barrier manufacturer; Contractor shall replace overexposed materials at their expense and retest.

END OF SECTION 07 27 26

SECTION 07 41 13 - FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Standing-seam architectural metal roof panels for Utility Chaseway.

B. Related Requirements:
1. Section 06 10 00 - Rough Carpentry
2. Section 07 62 00 - Sheet Metal Flashing & Trim
3. Section 07 92 00 - Joint Sealants

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Government (C.O.R.), metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Roof Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified Metal Panel Roof Systems Installers.

B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.

C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines unless permitted by the manufacturer.

D. Material to comply with:

1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof area and wall as shown on Drawings; approximately 12 feet (3.5 m) square by full thickness, including attachments, underlayment, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Government specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: **25** years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 4**0** years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period

1. Warranty Period: **20** years from date of Substantial Completion.

D. Installer Warranty: Installer to provide warranty agreeing to repair or replace metal roof panels, trim, or accessories that fails due to poor workmanship or faulty installation. 2 Year.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 32 or initial SRI not less than 39 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 at the following test-pressure difference:

1. 0.0028 cfm/sf maximum at a differential pressure of +/-20 pounds per square foot.

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. No water penetration up to 20 psf differential pressure

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

1. Provide manufacturer's test data, signed and sealed by a registered professional engineer, on a test specimen with no end lap, indicating that no water leakage was observed during the testing period of 6 hours with a 6" water head on the specimen.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

H. Wind Pressure;
1. Provide manufacturer's test data, signed and sealed by a registered professional engineer, substantiating that roof system will meet the allowable wind pressures using an appropriate Factor of Safety in accordance with AISI S-100

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

B. Architectural Standing Seam Metal Roof Panels: Formed with 180 Degree Seam.

1. Manufacturers:
   a. Petersen Aluminum – Product: Pac-150 with 180 Degree Seam
   b. Berridge Mfg. Co, Houston, TX
   c. McElroy Metal, Inc., Clinton, IL
   d. Atas Aluminum Corp, Allentown, PA

2. Metallic-Coated Steel Sheet: aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50, coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

   a. Thickness: 0.032 inch (0.81 mm).
   b. Surface: Smooth, flat finish.
   c. Exterior Finish: Metallic fluoropolymer.
   d. Color: As selected by Government from manufacturer's full range.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions for fastening substrate panel to roof deck.

2.3 SUBSTRATE BOARD

A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. USG
2. Thickness: Type X, 5/8 inch (16 mm)
3. Surface Finish: [**Factory primed**]

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D1970.
3. Manufacturers:

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.5 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a

maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

H. Insulation: Rigid stone wool insulation (Basis of Design: Rockwool Toprock® DD) in layers and thickness to comply with energy code. Mechanically attached.

I. Nailable noncombustible glass mat gypsum cover board which complies with roof manufacturer’s requirements for attachment of cleats for the roof panels.

2.6 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
1. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. .

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Watertight Installation:

a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
1. Connect downspouts to underground drainage system indicated.

J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13

SECTION 07 42 46 - HIGH DENSITY CEMENTITIOUS WALL PANELS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fiber-reinforced cementitious wall panels mounted using the drained and back ventilated (D&BV) rainscreen design principles.
B. Panel fasteners and accessories.
C. Metal Sub-Framing Support System

1.2 RELATED SECTIONS

A. 05 40 00 Cold-Formed Metal Framing
B. 06 10 00 Rough Carpentry
C. 07 21 00 Thermal Insulation
D. 07 27 26 Fluid-Applied Membrane Air Barriers
E. 07 62 00 Sheet Metal Flashing and Trim

1.3 REFERENCES

A. ASTM International
1. ASTM C120-90: Standard Test Methods of Flexure Testing of Slate (Breaking Load, Modulus of Rupture, Modulus of Elasticity)
2. ASTM C1185: Standard Test Methods for Sampling and Testing Non Asbestos Fiber Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards
3. ASTM C1186: Standard Specification for Flat Fiber-Cement Sheets
4. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
5. ASTM E136: Standard Test Method for Behavior or Materials in a Vertical Tub Furnace
6. ASTM E228: Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer
7. ATSM G155: Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
8. ASTM E330: Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
9. ASTM E331: Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

B. Additional
1. ICC AC 90: Acceptance Criteria for Fiber Cement Siding used as Exterior Wall Siding
2. IBC 1403.2: Reference Standard for Selection of Weather Resistive Barriers
3. AAMA 509: Test and Classification Method for Drained and Back-Ventilated Rainscreen Wall Cladding Systems
4. EN12467: European Committee for Standardization: Fiber Cement Flat Sheets. Product Specification and Test Methods
5. NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components.
6. Florida Building Code: Test Application Standard (TAS) 203: Criteria for testing Products subject to Cyclic Wind Pressure Loading
7. IAPMO Test

1.4 SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures
B. Product Data: Manufacturer's data sheets on each product to be used, including, but not limited to:
    1. Preparation instructions and Recommendations
    2. Storage and Handling Requirement and Recommendations
    3. Installation methods for the supporting framework and the panels
C. Shop Drawings: Submit detailed shop drawings showing:
    1. Integrated engineered system with single source responsibility of shop drawings to incorporate panel manufacturer and sub-framing. Sub-framing must have fixed and sliding points that addresses thermal cycling for both panels and sub-framing. Engineering Calculations: Submit stamped calculations by licensed engineer as required by local building code
D. Samples
    1. 1 inch by 3.25 inch minimum fiber cement color samples for selection by Government
    2. One 4 inch by 5.8 inch fiber cement panel in selected color and surface finish
    3. Provide samples of each type of panel fastener
E. Provide manufacturer's Design and Installation Manual
F. Provide test reports indication compliance with performance criteria.
G. ICC Evaluation Report for Installation on a Rear Ventilated Open Joint System
H. Provide manufacturer's sample warranty
I. Design Loads as required by applicable codes for Project location.
    1. System shall be optimized based on design loads.
    2. Maximum panel deflection: 1/300 or applicable for product of span or less of span when tested in accordance with positive and negative pressures and as required to prevent cracking or damage to panel facing.
    3. Comply with applicable seismic requirements for Project location
    4. Adequately resist wind forces and uplift for Project location for parapet and corner panels tested in accordance with ASTM E330.
    5. Accommodate movement of cladding components without undue stress on fasteners or other detrimental effects, when subjected to seasonal temperature range of:
        a. Ambient: [120 degrees F] [67 degrees C]
        b. Cladding surface: [180 degrees F] [100 degrees C]
    6. Accommodate tolerances of support structure.
    7. Provide panels and panel supports capable of the following:
        a. Wind Loads: Panel and sub-framing system design meets wind load requirements as defined by structural design and local building codes.
        b. Deflection Limits: Withstand deflection L/300 maximum
    8. Provide thermal U-value analysis on typical wall assembly to incorporate specified insulation and cavity depth(s).

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum of twenty (20) years' experience in the production of fiber-reinforced cementitious panels
B. Installer Qualifications: Acceptable to panel manufacturer's representative, with a minimum of five (5) years of proven experience in the installation of the specified products on projects of a similar size and scope.

C. Mock-up shall incorporate panels and all accessories

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and handling to comply with Design and Installation Manual

1.7 WARRANTY

A. Manufacturer standard warranty against material failure for a period of twenty (20) years from date of delivery. Warranty only available when material is installed in accordance with manufacturer's design and installation manual with shop drawings approved by manufacturer.

B. Failures include:

1. Structural failure: Water Tightness, Frost Resistance, Mechanical and Physical Characteristics per EN standards and manufacturer's performance values. No visible irregular deviation of color within one panel for 10 years.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: Swisspearl® by Cladding Corp: www.claddingcorp.com

1. Swisspearl Fiber Cement Panel - Carat
2. Panel Thickness: 12mm
3. Color: As selected by Government from manufacturer's full range.
4. Panel size: As shown on Governmentural drawings [Maximum panels size of 1250mm x 3050mm]

1. Drawings, cut sheets, performance and test data.
2. List of projects of similar scope and photographs of exisiting installations.
3. Test reports indicating compliance with the performance criteria.
4. Documentation proving manufacturing process is in compliance with performance criteria.

B. Other acceptable manufacturers:

1. Equitone Fiber Cement Panel – Natura or Pictura

2.2 PANEL MATERIALS

A. Panels made with:

1. Portland cement (greater than 70% of composition)
2. Polyvinyl alcohol fibers (PVA)
3. High Performance finish on all six sides (face, rear, and all edges)
4. ASTM C1186 at Type A Grade IV fiber-cement boards, in accordance with Section 1404.10 and 1405.16 of the IBC.

B. Panels must be air cured for a minimum of 4 weeks

C. The following characteristics are not acceptable:

1. Autoclaved products
2. Products reinforced with only wood/cellulose fibers
3. Efflorescence
4. Combustible products without ASTM E 136 approval
5. Color Change greater than E 2.0 per ASTM G155.

D. Panel Fastening: Concealed: Concealed Fastening System

2.3 FABRICATION

A. Fabricate panels by a manufactured approved fabricator
B. Dimensional tolerances
    1. Overall panel dimensions within 1mm of panel width and height
    2. Squareness within 0.5mm per meter
C. Labeling: Apply identification label to back side of each fabricated panel

2.4 SUB-FRAMING SYSTEM

A. Basis of Design: ECO Vci.40 by ECO Cladding: www.ecocladding.com
B. Sub-Framing Requirements:
    1. Thermal Modeling: Attachment system must be thermally modeled to demonstrate, at minimum, a compliance with ANSI/ASHRAE 90.1-2010 maximum U-Value for walls.
    2. Thermally Broken Sub-Framing: Continuous framing profiles (including C- or Z-shaped sections or furring) penetrating insulation are not permitted.
    3. Internal Shimming: Sub-framing will incorporate brackets with internal shimming for out of plumb conditions, with at least 1 1/2" of built in adjustability.
    4. Cavity Ventilation: Sub-framing system shall accommodate positive drainage and ventilation for moisture control of the cavity
    5. Flatness: Sub-framing System shall be flat with no noticeable warpage, buckling, deflection or other surface irregularities. The back plate shall not bend or deflect when compressed against the air barrier membrane but instead create a compression seal.
    6. Fasteners: Minimum 304 series stainless steel fasteners and anchors of type, size and spacing required for type of substrate and project conditions, to meet performance requirements specified and as indicated in design calculations and shop drawings. Grommet fasteners should be used to ensure face seal of the bracket.
    7. Not Acceptable: Components made from galvanized steel, galvalume, or other carbon-based metals. Components made from FRP or fiberglass materials.
    8. Sub-Framing Manufacturer: 15 years' experience in rainscreen wall design in the United States.
    9. Single Sourced Engineered System: Integrated engineered system with single source responsibility of shop drawings to incorporate panel manufacturer and sub-framing. Sub-framing must have fixed and sliding points that addresses thermal cycling for both panels and sub-framing.
    10. Aluminum System: Made from 6000 series Governmentural grade aluminum to address corrosion.
    11. Stainless Steel: Minimum 304 series stainless steel brackets and/or profiles for system attachment.
    12. Finishes: Brackets and L shapes in mill finish and panel attachment profiles in black anodized finish.

2.4 VENTILATION REQUIREMENTS

A. Panels shall be rear ventilated with a continuous ventilation cavity.
    1. Cladding heights less than 20ft require minimum ¾" continuous vent cavity.
    2. Cladding heights more than 20ft, but less than 100ft, require minimum 1-1/4" continuous vent cavity.
    3. Cladding heights 100ft or great require minimum 1-3/4" continuous vent cavity.
B. All base, top, sill, and head conditions must have minimum ¾" clearance from panel edge and panel face to ensure proper ventilation.
C. Ventilation Cavity with Perforated Horizontal Profiles

1. Minimum ventilation gap to be 1.5”. Horizontal profiles should allow minimum 75% airflow. Continuous, non-perforated, horizontal profiles at not allowed.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of drained and back ventilated rain screen cladding
B. Do not proceed with cladding installation until deficiencies have been addressed

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.
B. Field dimension: Field verifies overall dimensions prior to panel fabrication.
C. Coordinate panel installation with rain drainage work, flashing trim, soffit, roofing, parapet, wall, and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.
D. Allow for scaffolding or mobile access to all parts of cladding.

3.3 INSTALLATION

A. Install panels in accordance with manufacturer’s Design and Installation Manual and approved shop drawings.
B. Install panels with appropriate joint layout and configuration. Vertical and horizontal joints shall be open. Typical joint spacing to be 5/16” wide. Minimum joint spacing allowed is ¼”.

3.4 QUALITY CONTROL

A. The installing contractor shall perform daily inspections of panel installation to maintain and confirm that tolerances are being met and that panel manufacturer’s DIM is complied with.
B. The owner may engage a third party inspection agency to verify that installed panels meet performance requirements and tolerances.

3.5 CLEANING, HANDLING, STORAGE AND PROTECTION

A. Panels should be handled and storage at jobsite per the manufacturer’s Design and Installation Manual.
B. Remove and replace broken, chipped, stained, or otherwise damaged panels.
C. Immediately after installing, wipe down panels. Do not use wire brushes, metallic tools, or abrasives for cleaning.
D. Protect cladding from roof run-off, splashed water, mud, sealants, bitumen, and other contaminants from remaining construction activities.
E. Without damaging completed work, provide protective boards at exposed external corners, which may be damaged by construction activities.

END OF SECTION 07 42 46

SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Substrate board.
3. Roof insulation.
4. Cover board.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples: For the following products:

1. Roof membrane and flashings, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures.

1. Zone 2 (Roof Area Perimeter): See Structural Construction.

    a. Location: From roof edge to 5 feet inside roof edge.

D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle SynTec Incorporated.
    b. Cooley Engineered Membranes.
    c. Custom Seal Roofing.
    d. Elevate roofing, lining, and wall systems.
    e. Flex Membrane International Corp.
    f. GAF.
    g. GenFlex Roofing Systems.
    h. Johns Manville; a Berkshire Hathaway company.
    i. Mule-Hide Products Co., Inc.
    j. Versico Roofing Systems.

2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, [55 mils] <Insert value> thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Thickness: 1/2 inch thick.
3. Surface Finish: Factory primed.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1 felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Atlas Molded Products; a Division of Atlas Roofing Corporation.
b. Atlas Roofing Corporation.
c. Carlisle SynTec Incorporated.
d. Dyplast Products.
e. Firestone Building Products.
f. Flex Membrane International Corp.
g. GAF.
h. Hunter Panels.
i. Insulfoam; Carlisle Construction Materials Company.

j. Johns Manville; a Berkshire Hathaway company.
k. Rmax, Inc.

2. Size: 48 by 48 inches.
3. Thickness:

a. Base Layer: [1-1/2 inches] <Insert thickness>.
b. Upper Layer: As required to achieve minimum R. valve.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Georgia-Pacific Gypsum LLC.
b. National Gypsum Company.
c. USG Corporation.

2. Thickness: 1/2 inch.
3. Surface Finish: Factory primed.

D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.2 PREPARATION

A. Perform insulation fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier.

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
5. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

   a. Locate end joints over crests of decking.
   b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   e. Fill gaps exceeding 1/4 inch with insulation.
   f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   g. Loosely lay base layer of insulation units over substrate.
   h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

   a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
   b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   e. Fill gaps exceeding 1/4 inch with insulation.
   f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   g. Loosely lay each layer of insulation units over substrate.
   h. Adhere each layer of insulation to substrate using adhesive as follows:

      1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
      2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

    a. Trim cover board so that water flow is unrestricted.

2. Cut and fit cover board tight to nailers, projections, and penetrations.
3. Loosely lay cover board over substrate.
4. Adhere cover board to substrate using adhesive as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and beneath roof membrane.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric-backed roof membrane. Do not apply to splice area of roof membrane.

G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

I. Apply roof membrane with side laps shingled with slope of roof deck where possible.

J. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to The Contracting Officer / Government.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Flashing and sheet metal not specifically described in other Sections of these Specifications but required to prevent penetration of water through the exterior shell of the building.

B. Related Requirements:
1. Section 04 20 00 – Unit Masonry
2. Section 06 10 00 – Rough Carpentry for wood nailers, curbs, and blocking.
3. Section 07 92 00 – Joint Sealants

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.6 WARRANTY

A. All warranties shall begin at the date of Substantial Completion of the project.

B. Fluoropolymer Paint Warranty: The materials stock manufacturer shall provide a twenty (20) year warranty of the paint finish on all components of flashing and sheet metal against:
1. Cracking, checking, and peeling of the surface.
2. Fading of the color not to exceed 5 Hunter Units, per ASTM D2244.
3. Chalking of the surface not to exceed No. 8 per ASTM D659.

PART 2 - PRODUCTS

2.1 MATERIALS AND THICKNESS

A. Where sheet metal is required, and no material or gauge is indicated on the Drawings, provide the highest quality and gauge commensurate with the referenced standards.

B. Metals:
2. Stepped in wall flashing, counter flashing, and through wall flashing: 24 gauge stainless steel.
3. Base flashing and below grade insulation protection, as indicated on drawings: heavy gauge Type 304 stainless steel with Number 2D Finish – dull finish.

2.2 NAILS, RIVETS AND FASTENERS

A. Use only stainless steel components.

2.3 STAINLESS STEEL AND ALUMINUM FLASHING THROUGH WALL FLASHING

A. Through wall flashing shall be stainless steel 24 gauge. Powder coated aluminum. 0125” thick where indicated on drawings at base flashing with profile extension over exposed insulation.

B. Manufacturer flat, sheet metal, through wall flashing for embedment in masonry with rib at approx. 3” intervals, along the length of the flashing to provide an integral bond with the mortar.

C. Fabricate flashings in sections at least 96”, but not more than, 144”. Provide splice plates at all end joints of smooth metal flashing.

D. Profile of flashings shall be fabricated in one piece from exterior drip edge to top of vertical leg.

E. Where indicated on the drawings fabricate with a receiver for an interlocking counterflashing. Counterflashing to be fabricated of the same material / weight as flashing.

F. Flashing shall fit tightly into the corner created between sill / lintel and the backup material.

G. Extend flashing vertically from the sill or lintel a distance not less than eight (8) inches.

H. Fabricate through wall flashing with an outer drip edge, unless otherwise indicated. Uniformly extend flashing beyond the vertical face of the wall by ½" and then bend outer drip edge down uniformly at 30º.

I. At all discontinuous flashings, provide tightly formed and sealed end dams per standard SMACNA details. No flashing installation shall be left open ended, without an end dam. End dams must be shop fabricated and set to allow one splice location centered on the opening.

J. Anchor flashings only as required to maintain positioning. Seal all anchorage locations to make completely watertight.

J. Materials:
   1. 24 gauge, type 304, stainless steel, complying with ASTM A240A / A240M.
   2. Powder coated aluminum, .0125" thick.

K. Manufacturer:
   1. Cheney Flashing Company, 623 Prospect St Trenton, NJ 08618. (609) 394-8175
   2. Hohmann & Barnard, Inc., 30 Rasons Ct Hauppauge, New York 11788. (631) 234-0600
   3. Keystone Flashing Company, Inc 5119 N. 2nd St. Philadelphia, PA 19120. (800) 526-8348
   4. Sandell Manuf'ing Company, Inc. 310 Wayto Rd Schenectady, NY 12303. (518) 357-9757

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
   5. Torch cutting of sheet metal flashing and trim is not permitted.

6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:

1. Copings.
2. Roof-edge drainage systems.
3. Reglets and counterflashings.

B. Related Requirements:

1. Section 04 22 00 "Concrete Unit Masonry" for installing embedded reglets and for masonry through-wall flashing with receiver for counterflashing.
2. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 07 41 13 “Metal Roof Panels” for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 07 54 23 “TPO Roofing”.
5. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated, sheet metal flashing and trim.
6. Section 07 72 00 "Roof Accessories" for manufactured roof curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
7. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1. Meet with Government, Government, Government's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof specialty.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Plans, expansion-joint locations, keyed details, and attachments to other work. Distinguish between factory pre manufactured- and field-assembled installation.
2. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Details of termination points and assemblies, including fixed points.
5. Details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of roof specialty copings and roof-edge flashings that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

B. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.

C. Research Reports: For copings and roof-edge flashings, from an agency acceptable to authorities having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

D. Qualification Statements: For manufacturer.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roof specialties to be included in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products that are FM Approvals listed for specified class and ANSI/SPRI/FM 4435/ES-1 tested to specified design pressure.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockup of typical roof edge, including fascia, scupper, and downspout, approximately 10 ft. (3.0 m) long, including supporting construction, seams, attachments, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Government specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate roof specialties with roofing system, exterior wall system, air barrier, flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, weathertight, secure, and noncorrosive installation.

1. Performance Coordination: Coordinate with the Work of roofing and exterior wall Sections to ensure that roof specialties provided under the Work of this Section meet or exceed specified roofing and exterior wall design performance requirements.

B. Confirm and coordinate compatibility of materials and comply with warranty requirements of roofing system manufacturer.

C. Coordinate roof specialties layout and seams with sizes and locations of joints and seams in adjacent materials.

1.11 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 54 23 TPO Roofing.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finishes or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roof specialties from single manufacturer providing roofing-system warranty specified in Section 07 54 23 TPO Roofing.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings and roof-edge specialties that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 ft. (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ATAS International, Inc.
   b. Berridge Manufacturing Company.
   c. Castle Metal Products.
   d. Cheney Flashing Company.
   e. Drexel Metals.
   f. Exceptional Metals.
   g. Merchant and Evans.
   h. Metal-Era, Inc.
   i. OMG, Inc.

j. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
k. Perimeter Systems; a division of SAF.
l. SAF (Southern Aluminum Finishing Company, Inc.).

2. Formed Aluminum Coping Caps: Aluminum sheet, 0.050 inch thick.

a. Surface: Smooth, flat finish.
b. Finish: Two-coat fluoropolymer.
c. Color: To match color of 07 42 46 High Density Cementitious Wall Panels.

3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ATAS International, Inc.
2. Berger Building Products, Inc.
3. Castle Metal Products.
4. Cheney Flashing Company.
5. CopperCraft by FABRAL.
6. Drexel Metals.
7. Exceptional Metals.
8. Merchant and Evans.
9. Metal-Era, Inc.
10. OMG, Inc.
11. Perimeter Systems; a division of SAF.
12. SAF (Southern Aluminum Finishing Company, Inc.).

B. Gutters: Manufactured in uniform section lengths not exceeding 12 ft. (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Formed Aluminum Sheet: 0.040 inch (1.02 mm) thick.
2. Gutter Profile Basis of Design: Metal Era Seal-Tite WR Gutter
3. Size: 5.25”/5.25”/6.25”

C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum Sheet: 0.040 inch (1.02 mm) thick.
2. Downspout Profile Basis of Design: Metal Era Industrial Closed Face, Style 1 Strap Version mounted at rear of downspout.

D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

1. Formed Aluminum Sheet: 0.032 inch (0.81 mm) thick.
2. Scupper Profile Basis of Design: Metal Era Thru-Wall Scupper with Raised Collector Box.

E. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout**,** exterior flange trim, and built-in overflow.
1. Formed Aluminum Sheet: 0.032 inch (0.81 mm) thick.
2. Conductor Head Profile Basis of Design: Metal Era Collector Box Welded Version Style 2.

F. Finishes:

1. Aluminum: Two-coat fluoropolymer.

a. Color: To match Copings**.**

2.5 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berridge Manufacturing Company.
2. 2. Castle Metal Products.
3. 3. Cheney Flashing Company.
4. 4. Drexel Metals.
5. 5. Exceptional Metals.
6. 6. Fry Reglet Corporation.
7. 7. Heckmann Building Products, Inc.
8. 8. Keystone Flashing Company, Inc.
9. 9. Metal-Era, Inc.
10. 10. OMG, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Metallic-Coated Steel Sheet: Nominal 0.028-inch (0.71-mm) thickness.
2. Formed Stainless Steel Sheet: 0.0250 inch (0.635 mm) thick.
3. Corners: Factory mitered and continuously welded.
4. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
5. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
6. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 ft. (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Metallic-Coated Steel Sheet: Nominal 0.028-inch (0.71-mm) thickness.
2. Formed Aluminum Sheet: 0.032 inch (0.81 mm) thick.
3. Formed Stainless Steel Sheet: 0.0250 inch (0.635 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Finishes:

1. Metallic-Coated Steel: Two-coat fluoropolymer.

   a. Color: As selected by Government from manufacturer's full range.

2. Aluminum: Two-coat fluoropolymer.

   a. Color: As selected by Government from manufacturer's full range.

3. Stainless Steel: ASTM A480/A480M No. 2B bright, cold rolled, unpolished.

2.6 SHEET METAL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 (Z275) coating designation.

B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

   a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.

C. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise, mill finished.

D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.7 UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment complying with requirements of Section 07 41 13 Metal Roof Panels: Provide self-adhering, cold-applied, sheet underlayment, a minimum 30 mils (0.76 mm) thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (minus 29 deg C) or lower; ASTM D1970/D1970M.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ALCO Products

b. APOC
c. Epilay
d. Mid-States Asphalt (MSA)
e. Polyglass
f. Resisto (Division of Soprema)

2.8 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Roof specialty manufacturer's recommended fasteners, designed to meet performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual” for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

B. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

INSTALLATION, GENERAL

D. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

E. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer's written installation instructions.

1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

F. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 ft. (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

G. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

H. Seal concealed joints with butyl sealant as required by roof specialty manufacturer.

I. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

J. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at 30-inch (762-mm) centers.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at 24-inch (610-mm) centers.

3.4 INSTALLATION OF ROOF-EDGE SPECIALTIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches (610 mm) apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 ft. (15.2 m) apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal or solder exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper discharge.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See 04 22 00 "Concrete Unit Masonry" for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting.

C. Clean and neutralize flux materials. Clean off excess solder and sealants.

D. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

E. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Government.

END OF SECTION 07 71 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Roof Hatches.
      a. Personnel Series metal, single door hatches used by personnel.
   2. Accessory Products for Roof Hatches
      a. Safety Railings for all roof hatches
      b. Safety posts for vertical ladder access roof hatches
      c. Roof Hatch Mounted Hoist System

B. Related Requirements:
   1. Division 05 50 00 “Metal Fabrications” for metal vertical ladders, ships for access to roof hatches.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak proof, watertight, secure and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Shop Drawings:
   1. Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected Work.
      a. Hatch Units: Show types, elevations, thickness of metals, and full-size profiles.
      b. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
      c. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of unit.

B. Product Data: Manufacturer’s technical data for each type of hatch assembly, including setting drawings, templates, finish requirements, and details of anchorage devices.
   1. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.

1.4 CLOSEOUT SUBMITTALS
   1. Installation, Operating and Maintenance manuals

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
   2. OSHA 29 CFR 1926.502 Fall protection systems criteria

3. International Building Code (IBC) Section 1013.6 Roof Access
4. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof

1.6 WARRANTY

A. Provide manufacturer's standard 5-year warranty. Roof hatches shall be free from manufacturing defects in materials and fabrication for a period of 5 years from the date of shipment. Should a product fail to function in normal use within this period, manufacturer shall furnish a replacement or new part at manufacturer's discretion.

PART 2 - PRODUCTS

2.1 PERSONNEL ROOF HATCH - THERMALLY BROKEN

A. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or approved equal:
   1. Basis of Design: Bilco Co. Type S-50TB
   2. Babcock-Davis
   3. Nystrom

B. Type and Size: Personnel Single-leaf metal lid, 30 inches by 36 inches.
   1. Loads: Cover stiffened to withstand a live load of 40-lb/sq. ft. with a maximum deflection of 1/150 of the span and 20-lb/sq. ft. internal uplift load.
   2. Hatch Material
      a. Cover: 11 GAGE ALUMINUM cover with 4-inch rigid insulation covered by 11 GAGE ALUMINUM cover liner.
      b. Cover insulation: Foil faced Single layer 3-inch (76 mm) rigid polyisocyanurate insulation covered by 0.0907-inch (2.3 mm) aluminum liner. (R-value = 20.3) (U=0.284 W/m2K)
      c. Curb: 11 GAGE ALUMINUM with a single wall curb with integral railing ready EZ tabbed counterflash mounting flange. Mounting flange continuous around base of frame.
         1) Fabricate curbs to a height of 12 inches above roofing surface unless otherwise indicated.
      d. Curb insulation: Foil faced Single layer 3 inch (76 mm) continuous rigid polyisocyanurate insulation. (R-value = 20.3) (U=0. 284 W/m2K)
      e. Finish: MILL FINISHED ALUMINUM
      f. Hardware: Zinc plated steel
         1) Hinge Assembly: Pintle hinge with stainless steel hinge pin
         2) Spring: Gas spring with integrated damper
         3) Hold open device: Automatic zinc plated steel hold open arm with red vinyl grip handle.
         4) Latch: Zinc plated steel spring type slam latch with inside and outside operating turn handles and padlock hasp provisions.
         5) Pull handle: Interior pull down handle, powder coated safety yellow
         6) Gasket: Extruded EPDM adhesive back seal, continuous around cover

2.2 ACCESSORY PRODUCTS

A. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
   1. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or approved equal:
      a. Bilco Co.
      b. Nystrom model: SRC
      c. Babcock-Davis
   2. Height: Height: 42 inches above finished roof deck.
   3. Rails:
      a. Material: Aluminum pipe, 1-1/4 inch, (1.66 inch outside diameter) schedule 40 pipe
      b. Fittings: Cast aluminum alloy with set screw hold
      c. Mounting brackets: 3/16 inch steel, zinc plated with nut backing plate
      d. Exit:Self closing gate, Galvanized steel 1 ¼ inch (32 mm) tubular steel self closing with coil spring

B. Ladder Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
   1. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or approved equal: Bilco
   2. Height: Height: [42 inches (1060 mm)] above finished roof deck.
   3. Materials: [Steel tube].
   4. Post: 1 ½" x 1 ½" x 1/8".
   5. Finish : STEEL YELLOW POWDER COAT (Model SPY)

C. Roof Hatch Mounted Hoist System
   1. Basis of Design: Kattsafe KH0001
   2. 100 lbs capacity
   3. Include KH-CNET 3' x 3' Cargo Net
   4. Coordinate with Safety Railing System

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine site conditions under which work of this Section will be performed.
   1. Identify conditions detrimental to providing proper quality and timely completions of work.
   2. Do not proceed with installation until detrimental conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations.

B. Securely anchor roof accessories in compliance with manufacturer's instructions and capable of resisting indicated loads.

C. Set units plumb, level, and true to line without warp or rack.

D. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

E. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

F. Incompatible Materials: Apply protective coating to separate aluminum from incompatible materials.

G. Verify that roof hatch operates properly. Clean, lubricate and adjust operating mechanism and hardware.

H. Attach safety railing system to roof-hatch curb.

3.3 ADJUSTING

A. Adjust movable parts for smooth operation.

B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.4 CLEANING

A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency. CLOSEOUT SUBMITTALS

C. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      1) UL in its "Fire Resistance Directory."
      2) Intertek Group in its "Directory of Listed Building Products."
      3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. 3M Fire Protection Products.
   b. Hilti, Inc.
   c. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

D. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

E. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

F. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

G. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Government will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: [C-AJ-] [W-L-] 2001-2999.
2. F-Rating: 1 hour and 2 hours.
3. T-Rating: 1 hour and 2 hours.
4. W-Rating: No leakage of water at completion of water leakage testing.
5. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction laboratory test reports.

C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As selected by The Contracting Officer / Government from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. May National Associates, Inc.; a subsidiary of Sika Corporation.
    b. Pecora Corporation.
    c. Sika Corporation; Joint Sealants.
    d. The Dow Chemical Company.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. May National Associates, Inc.; a subsidiary of Sika Corporation.
    b. Pecora Corporation.
    c. Sika Corporation; Joint Sealants.
    d. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Sika Corporation; Joint Sealants.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adfast.
    b. GE Construction Sealants; Momentive Performance Materials Inc.
    c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    d. Pecora Corporation.
    e. Soudal USA.
    f. The Dow Chemical Company.
    g. Tremco Incorporated.

B. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Everkem Diversified Products, Inc.
b. Franklin International.
c. May National Associates, Inc.; a subsidiary of Sika Corporation.
d. Pecora Corporation.
e. Sherwin-Williams Company (The).
f. Tremco Incorporated.

2.6 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.
b. Alcot Plastics Ltd.
c. BASF Corporation.
d. Construction Foam Products; a division of Nomaco, Inc.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants 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.

B. Evaluation of Field-Adhesion-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.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-#1.

1. Joint Locations:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Joints between different materials listed above.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-#2.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between plant-precast architectural concrete units.
c. Control and expansion joints in unit masonry.
d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces JS-#3.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT Insert joint sealant.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors color.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-#4.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry and walls.
d. Joints on underside of plant-precast structural concrete beams.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-#5.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-#6.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics JS-#7.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by The Contracting Officer / Government from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Hollow-metal work.
   2. Fire rated hollow metal doors and frames

B. Related Requirements:
   1. Section 07 92 00 “Joint Sealants”
   2. Section 08 71 00 "Door Hardware for door hardware for hollow-metal doors.
   3. Section 08 80 00 “Glazing” for glass view panels in hollow metal doors.
   4. Section 09 91 23 “Painting” for finishing of doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference at job site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:
1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.
10. Doors to be factory finished and finish requirements.
11. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:
1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish.
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
   a. Hollow Metal Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

C. Sample Warranty: For special warranty.

D. Quality Standard Compliance Certificates.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody.

B. Vendor Qualifications: A vendor that is certified for chain of custody.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

D. Comply with requirements of referenced standard and manufacturer's written instructions.

E. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

F. Mark each door on bottom rail with opening number used on Shop Drawings.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.11 LABEL DOOR REQUIREMENTS

A. Fire Ratings Compliance: Comply with the label requirements of NFPA and applicable local codes. Fabricate doors and frames in accordance with requirements of NFPA Standard No. 80 and U.L. Standards asfollows:
   1. Positive Pressure Testing UL 10C

B. Ratings Certifications
   1. Provide U.L. labels permanently fastened on each door that is within the size limitations established by NFPA and U.L. forlabeling.
   2. Provide anchors for U.L. labeled frames required by the authority having jurisdiction.

1.12 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hollow Metal Doors and Frames:
      a. Ceco Door Products; Assa Abloy Group company
      b. Curries Company; Assa Abloy Group company
      c. Pioneer Industries; Assa Abloy Group company
      d. Steelcraft; Allegion company

B. Source Limitations: Obtain hollow-metal doors and frames from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 (ZF120) coating.
      d. Edge Construction: Model 2, seamless
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 (ZF120) coating.
   b. Construction: Face welded unless otherwise indicated.
4. Exposed Finish: Factory.

2.4 INTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Cold rolled steel; stretcher-leveled standard flatness; minimum thickness of 0.053 inch.
      d. Edge Construction: Model 2, seamless
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   3. Frames:
      a. Materials: Fabricated from either commercial grade cold-rolled steel conforming to ASTM A1008 or commercial grade hot-rolled and pickled steel conforming to ASTM A1011, minimum 0.053” thick.
      b. Construction: All miters clean cut, reinforced, fully seam welded with exposed welds ground smooth.
   4. Exposed Finish: Factory.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
   4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel: Commercial quality, hot dipped, A-60 galvannealed steel in accordance with ASTM A653, “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:
   1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
   2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
   3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches
   4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
   5. Bottom Edge Closures: Close bottom edges of doors with flush end closures of same material as face sheets.
   6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
   5. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
         1) Two anchors per jamb up to 60 inches high.
         2) Three anchors per jamb from 60 to 90 inches high.
         3) Four anchors per jamb from 90 to 120 inches high.
         4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
      b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.
         4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      c. Compression Type: Not less than two anchors in each frame.
      d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
   6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
8. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
   2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   3. Provide loose stops and moldings on inside of hollow-metal work.
   4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
   4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
   5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
   6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
   7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
   8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 41 13: ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes aluminum storefront doors for the greenhouse structure (interior and exterior).

B. Aluminum Entrance Door:
   1. Basis of Design Kawneer 500 Swing Door:
      a. Wide stile
      b. Vertical face dimension: 5" (127.0 mm)
      c. Depth: 1-3/4" (44.5 mm)
      d. High-traffic applications

C. Related Sections:
   1. 07 92 00: Joint Sealants
   2. 08 71 00: Door Hardware
   3. 08 80 00: Glazing
   4. 13 34 13.13: Glazed Structures – Greenhouses
   5. 28 05 00: Electronic Safety and Security System Requirements

1.3 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

A. General Performance:
   1. Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Wind Loads:
   1. The entrance system shall include anchorage that is capable of withstanding the wind load design pressures based on the International Building Code, 2024 Edition.

C. Air Leakage:
   1. For single-acting offset pivot or butt-hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 1.57 psf (75 Pa) for single doors and pairs of doors.
   2. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft^2.

D. Structural-Test Performance:
   1. Corner strength shall be tested per the Kawneer or equivalent manufacturer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity.

1.5 SUBMITTALS

A. Product Data:
   1. For each type of aluminum-framed entrance door indicated, include:
      a. Construction details
      b. Material descriptions
      c. Fabrication methods
      d. Dimensions of individual components and profiles
      e. Hardware
      f. Finishes
      g. Installation instructions

B. Shop Drawings:
   1. Plans
   2. Elevations
   3. Sections
   4. Details
   5. Hardware
   6. Attachments to other work
   7. Operational clearances
   8. Installation details

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.
   2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:
   1. Provide a verification sample for aluminum-framed entrance doors and required components.

E. Product Test Reports:
   1. Provide test reports for each type of aluminum-framed entrance door used in the project.

2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
3. Test reports must indicate compliance with performance requirements.

F. Fabrication Sample:
1. Provide a fabrication sample of a corner, consisting of a door stile and rail and using full-size components that show details of the following:
   a. Joinery
   b. Glazing

G. Entrance Door Hardware Schedule:
1. Schedule shall be prepared by or under the supervision of supplier.
2. Schedule shall detail fabrication and assembly of entrance door hardware, including procedures and diagrams.
3. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:
1. Manufacturer must be capable of fabricating aluminum-framed entrance doors and storefronts that meet or exceed the stated performance requirements.
2. Manufacturer must document this performance by the inclusion of test reports and calculations.

C. Source Limitations:
1. Obtain aluminum-framed entrance doors through one source from a single manufacturer.

D. Mockups:
1. Build mockup for the type(s) of swing entrance door(s) indicated, in location(s) shown on drawings.

E. Pre-installation Conference:
1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.7 PROJECT CONDITIONS

A. Field Measurements:
1. Verify actual dimensions of aluminum-framed entrance door openings by field measurements before fabrication.
2. Indicate measurements on shop drawings.

1.8 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
   1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:
   1. Kawneer Company, Inc. or equivalent
   2. The door stile and rail face dimensions of the entrance door will be as follows:
      a. Basis of Design Kawneer 500 Swing Door:
         1) Vertical face dimension: 5" (127.0 mm)
         2) Top Rail: 5" (127.0 mm)
         3) Bottom Rail: 10" (254.0 mm)
   3. Major portions of the door members shall be 0.125" (3.2 mm) nominal thickness.
   4. Glazing molding shall be 0.05" (1.3 mm) thick.
   5. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
   6. Provide adjustable glass jacks to help center the glass in the door opening.
   7. Provide aluminum infill at bottom lite of door per drawings.

B. Substitutions:
   1. Refer to Division 01 Substitutions Section for procedures and submission requirements.
   2. Pre-Contract (Bidding Period) Substitutions:
      a. Submit written requests ten (10) days prior to bid date.
   3. Post-Contract (Construction Period) Substitutions:
      a. Submit written request in order to avoid installation and construction delays.
   4. Product Literature and Drawings:
      a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
   5. Certificates:
      a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for aluminum-framed entrance door system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum-framed entrance doors for a period of not less than ten (10) years. (*Company Name*)
   6. Test Reports:
      a. Submit test reports verifying compliance with each test requirement required by the project.
   7. Samples:

a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance:
1. Acceptance will be in written form, either as an addendum or modification.
2. Acceptance will be documented by a formal change order signed by the owner and contractor.

2.2 MATERIALS

A. Aluminum Extrusions:
1. Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish.
2. Not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.

B. Fasteners:
1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories:
1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

D. Reinforcing Members:
1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

E. Weather Seals:
1. Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material.
2. Comply with AAMA 701/702.

2.3 STOREFRONT ENTRANCE DOOR FRAMING SYSTEM

A. Storefront Entrance Doors will be as scheduled and shall be coordinated with and integrated into the Greenhouse structure.

2.4 GLAZING

A. Glazing shall comply with requirements in Division 08 Glazing Section.

B. Glazing Gaskets:

1. Manufacturer's standard compression types
2. Replaceable, extruded EPDM rubber

C. Spacers and Setting Blocks:
1. Manufacturer's standard elastomeric type

2.5 HARDWARE

A. General Hardware Requirements:
1. Provide manufacturer's standard hardware – coordinate with hardware schedule in spec section 08 71 00 - Door Hardware.
2. Hardware shall be fabricated from aluminum, stainless steel, or other corrosion-resistant material that is compatible with aluminum.
3. Hardware shall be designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.

2.6 FABRICATION

A. Fabricate aluminum-framed entrance doors in sizes indicated.

B. Coordinate all doors with Greenhouse construction.

C. Include a complete system for assembling components and anchoring doors.

D. Fabrication requirements:
1. Aluminum-framed glass doors shall be reglazable without dismantling perimeter framing.
2. Door corner construction:
   a. Mechanical clip fastening
   b. SIGMA deep-penetration plug welds
   c. 1-1/8" (28.6 mm) long fillet welds inside and outside of all four corners
   d. Hook-in type glazing stops with EPDM glazing gaskets reinforced with non-stretchable cord
3. Joint construction:
   a. Accurately fit and secure joints and corners.
   b. Make joints hairline in appearance.
4. Prepare components with internal reinforcement for door hardware.
5. Arrange fasteners and attachments to conceal from view.

E. Weather-stripping:
1. Provide weather-stripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.

2.7 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Basis of Design: Kawneer Permanodic® AA-M10C21A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear)

PART 3 EXECUTION

3.1 EXAMINATION

A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:
   1. Verify rough opening dimensions.
   2. Verify levelness of sill plate.
   3. Verify operational clearances.
   4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.
   5. Masonry Surfaces:
      a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
   6. Wood Frame Walls:
      a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.
      b. Ensure that nail heads are driven flush with surfaces in opening and within 3" (76.2 mm) of opening.
   7. Metal Surfaces:
      a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
      b. Ensure that metal surfaces are without sharp edges or offsets at joints.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with drawings, shop drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.

B. Install aluminum-framed entrance doors so that the doors:
   1. Are level, plumb, square, and true to line
   2. Are without distortion and do not impede thermal movement

3. Are anchored securely in place to structural support
4. Are in proper relation to wall flashing and other adjacent construction

C. Set the sill threshold in a bed of sealant, as indicated, for weathertight construction.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:
1. Upon owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
1. Protect installed product’s finish surfaces from damage during construction.

C. Cleaning:
1. Avoid damaging protective coatings and finishes.
2. Clean glass and aluminum surfaces of product immediately after installation.
3. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
4. Remove non-permanent labels and clean surfaces.
5. Remove excess sealants, glazing materials, dirt, and other substances.
6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 41 13

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

A. Section includes Kawneer Governmentural Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.
   1. Types of aluminum windows include:
      a. Kawneer Series 8400TL Thermal Windows
      b. Model 8410TL Fixed Window
      c. 4" (101.6 mm) frame depth
      d. AW-PG100-FW

B. Related Sections:
   1. 04 22 00 “Concrete Masonry Units”
   2. 07 27 26 “Fluid-Applied Membrane Air Barriers”
   3. 07 92 00 “Joint Sealants”

1.3 Definitions

A. Definitions: For fenestration industry standard terminology and definitions refer to American Governmentural Manufactures Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Window System Performance Requirements:

   1. Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS)
      a. Performance Class and Grade: AW-PG100 - 60" x 99" (1524 mm x 2515 mm) -FW.

   2. Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. The air leakage rate shall not exceed 0.10 cfm/ft^2 (0.5 L/s·m^2) at a static air pressure differential of 6.2 psf (300 Pa).

   3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331 and ASTM E 547. There shall be no leakage as defined in the test method at a static air pressure differential of 12 psf (574 Pa) or 15 psf (718 Pa).

   4. Uniform Load Deflection: A minimum static air pressure difference of 100 psf (4788 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member.

5. Uniform Load Structural Test: A minimum static air pressure difference of 150 psf (7182 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. The unit shall be evaluated after each load.
6. Component Testing: Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
7. Energy Efficiency:
   a. Thermal transmittance simulation results using NFRC 100 or AAMA 507 are based on a Center of Glass (COG) U-factor of 0.24 Btu/(hr·ft^2·°F) and a warm-edge spacer.
      1) U-Factor not more than .35 BTU/hr/sf/°F or NFRC 100 when using project specified glass.
   b. Condensation Resistance Test (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than (CRF) 67_{frame} and 66_{glass}.
8. Thermal Barrier Tests: Testing shall be in general accordance with AAMA 505 Dry Shrinkage and Composite Thermal Cycling test procedure, AAMA TIR-A8, Structural Performance of Composite Thermal Barrier systems.
9. Environmental Product Declarations (EPD): Shall have a Type III Product Specific EPD created from a Product Category Rule specific to North America.

C. Environmental Product Declarations (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

1.5 Submittals

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
   1. Recycled Content:
      a. Provide documentation that aluminum has a minimum of 40% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.
      b. Once product has shipped, provide project specific recycled content information, including:
         1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
         2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
         3) Indicate location recovery of recycled content.
         4) Indicate location of manufacturing facility.
   2. Environmental Product Declaration (EPD):
      a. Include a Type II Product-Specific EPD created from a Product Category Rule.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum windows and components required.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.6 Quality Assurance

A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements.” Do not modify size and dimensional requirements.
   1. Do not modify intended aesthetic effects, as judged solely by Government, except with Government's approval. If modifications are proposed, submit comprehensive explanatory data to Government for review.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination.”

1.7 Project Conditions

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 Warranty

A. Manufacturer’s Warranty: Submit, for Government’s acceptance, manufacturer’s standard warranty.
   1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

B. Insulating Glass: Warranted to be free from defects (excluding breakage) for a period of five (5) years.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:
   1. Kawneer Company Inc. or Equal
   2. Series 8400TL Thermal Windows
   3. Model 8410TL Fixed Window
   4. 4" (101.6 mm) frame depth
   5. AW-PG100-FW

B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.
   1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
   2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window installation and construction delays.
   3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
   4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum windows for a period of not less than ten (10) years.
   5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.

6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Government and Contractor.

2.2 Materials

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.78 mm) wall thickness at any location for the main frame and sash members.

B. Thermal Barrier:
1. Thermal Barrier: The thermal barrier shall be Kawneer IsoLock® with a nominal 3/8" (9.53 mm) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum.

C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 Window System

A. Basis of Design: Kawneer Series 8400TL Thermal Windows - Fixed Window.

2.4 Glazing

A. Glass and Glazing Materials: Refer to Division 08 Section “Glazing” for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Exterior glazing shall be silicone back bedding sealant. Interior glazing shall be snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

2.5 Hardware

A. General: None required.

B. Optional Muntin Grids: Extruded aluminum profiles. 6063-T6 alloy and temper as follows:
1. True Muntins
2. Between The Glass Muntins
3. Applied Muntins

C. Optional Exterior Panning and Interior Trims: Extruded aluminum, 6063-T6 alloy and temper, extruded to profiles and details indicated. Seal exterior joints with manufacturer's standard sealant to assure water-tight joints.

1. Exterior Panning and Trims: All panning profiles shall be a minimum thickness of 0.062" (1.57 mm) to match the profiles as shown the drawings. Any profile variations shall be submitted to the Government and/or Government for approval 10 days prior to bid date. All panning shall be factory fabricated for field assembly. All corner joinery shall be factory cut. Joinery at the sill shall be coped and butt-type construction. All preparations for assembly shall be completed by the window manufacturer. Upon assembly, panning frame joints shall be back-sealed to prevent moisture penetration.
2. Interior Trims: The interior face trim minimum wall thickness shall be 0.062" (1.57 mm). The face trim shall snap-fit onto concealed mounting clip. Exposed fasteners shall not be accepted. The mounting clip shall be extruded aluminum of 6063-T6 alloy and temper. The minimum wall thickness shall be 0.062" (1.57 mm). The trim clips shall be provided in 4" (101.6 mm) lengths and spaced a maximum of 18" (457.2 mm) center to center.

2.6 Fabrication

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fit joints; make joints flush, hairline and weatherproof.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   6. Provisions for field replacement of glazing.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Window Frame Joinery: Screw Spline, factory sealed frame corner joints.

C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

D. Fabricate aluminum windows that are re-glazable without dismantling framing.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093-inch (2.4 mm) thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.

G. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section “Glazing” and with AAMA/WDMA/CSA 101/I.S.2/A440-08 (NAFS).

H. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section “Glazing” and glazing system indicated. Provide glazing stops to match frame.

2.7 Aluminum Finishes

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:

1. Basis of Design: Kawneer Permanodic® AA-M10C21A41, AAMA 611, Class I Clear Anodic Coating (Color #14 Clear).

PART 3 - EXECUTION

3.1 Examination

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight window installation.
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
   3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.

E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.3 Field Quality Control

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
   1. Testing Methodology: Testing Standard shall be per AAMA 502 including reference to ASTM E 783 for Air Leakage Test and ASTM E 1105 for Water Penetration Test.
      a. Air Leakage Test: Conduct test in accordance with ASTM E 783 at a minimum uniform static test pressure of 6.2 psf (300 Pa). The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.
      b. Water Infiltration Test: Water penetration resistance tests shall be conducted in accordance with ASTM E 1105 at a static test pressure equal to 2/3 the specified water test pressure.
   2. Testing Extent: Government shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.
   3. Test Reports: Shall be prepared according to AAMA 502.

3.4 Adjusting, Cleaning, And Protection

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Sections:
1. Section 08 11 13 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
2. Section 28 13 00 "Access Control" for access control devices installed at door openings and provided as part of a security system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: For power, signal, and control wiring and including the following:

a. Details of interface of electrified door hardware and building safety and security systems.
b. Schematic diagram of systems that interface with electrified door hardware.
c. Point-to-point wiring.
d. Risers.
e. Elevations doors controlled by electrified door hardware.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final

door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
d. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
5) Fastenings and other pertinent information.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC).

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

H. Accessibility Requirements: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and Illinois Accessibility Code (IAC) for door hardware on doors in an accessible route.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.

c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Closers: Adjust door and gate closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

Keying Conference: Conduct conference at Project site to comply with requirements in Book 2 of the Standard Terms and Conditions of the Contract Documents "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant and Owner's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

5. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
6. Preliminary key system schematic diagram.
7. Requirements for key control system.
8. Requirements for access control.
9. Address for delivery of keys.

I. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Manufacturers standard warranty period.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. McKinney Products Company; an ASSA ABLOY Group company.
c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. McKinney Products Company; an ASSA ABLOY Group company.
c. Select Products Limited.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated in hardware sets.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.

2.5 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; mortise latchbolt; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.

2.6 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Door Controls International, Inc.
b. Rockwood Manufacturing Company.
c. Trimco.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Von Duprin
b. Corbin Russwin
c. Sargent

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: BEST.

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

B. Keys: Nickel silver or Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.

2.10 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.11 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.12 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. LCN.
b. Norton Door Controls
c. SARGENT

2.13 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Trimco.

2.14 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Rixson
b. Rockwood
c. SARGENT.

2.15 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.16 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

2.17 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hiawatha, Inc.
b. Rockwood Manufacturing Company.
c. Trimco.

2.18 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rockwood Manufacturing Company.
c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.19 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McKinney Products Company; an ASSA ABLOY Group company.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
c. Securitron Magnalock Corporation; an ASSA ABLOY Group company.

2.20 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.21 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including

adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SCHEDULE – COORDINATE WITH DOOR SCHEDULE

HARDWARE SET 1 – HEADHOUSE EXTERIOR ENTRY DOOR 01A

5	EA	HINGES	T4A3386 NRP 4.5 X 4.5	630	MCK
1	EA	ELECT THROUGH WIRE HINGE	4-WIRE – MATCH OTHER HINGES	630	MCK
2	EA	MANUAL FLUSH BOLT	555 x 12”	626	ROC
1	EA	DUST PROOF STRIKE	570	630	ROC
1	EA	FAIL SECURE LOCK	45HW7DEU 15S	630	BEST
1	EA	CLOSER w/HOLDER & STOP	CPS7500T	689	NOR
1	EA	OVERHEAD HOLDER	690S	630	SAR
2	EA	ARMOR PLATE	34” x 2” LDW	630	ROC
1	EA	THRESHOLD	252x3FG	628	PEM
2	EA	SWEEP	315CN	628	PEM
1	SET	ADHESIVE SEALS	S88	BLK	PEM
1	EA	MEETING EDGE SEAL	S44	BLK	PEM
2	EA	JAMB WEATHERSTRIPPING	2815M	628	PEM
1	EA	HEAD WEATHERSTRIPPING	2891S	628	PEM
1	SET	SECURITY ASTRAGAL	353 x P491 INSERT	628	PEM
1	EA	DRIP CAP	346C	628	PEM
2	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		

HARDWARE SET 2 – HEAD HOUSE EXTERIOR DOOR 01B

3	EA	HINGES	T4A3386 NRP 4.5 X 4.5	630	MCK
1	EA	RIM EXIT ONLY	98EO	626	VON
1	EA	CLOSER w/STOP	CPS7500	689	NOR
1	EA	ARMOR PLATE	34” x 2” LDW	630	ROC
1	EA	THRESHOLD	252x3FG	628	PEM
1	EA	SWEEP	315CN	628	PEM
2	EA	JAMB WEATHERSTRIPPING	2815M	628	PEM
1	EA	HEAD WEATHERSTRIPPING	2891S	628	PEM
1	SET	ADHESIVE SEALS	S88	BLK	PEM
1	EA	DRIP CAP	346C	628	PEM
1	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		
1	EA	EXIT ALARM	ES4300A-K4	-	DET
1	EA	CYLINDER	AS REQUIRED	626	BEST

HARDWARE SET 3 – HEAD HOUSE INTERIOR DOOR 01C

3	EA	HINGES	TA2714 4.5 X 4.5	652	MCK
1	EA	PASSAGE	45H0N 15S	630	BEST
1	EA	CLOSER w/STOP	CPS7500	689	NOR
1	EA	ARMOR PLATE	34” x 2” LDW	630	ROC
1	EA	THRESHOLD	252x3FG	628	PEM
1	EA	SWEEP	315CN	628	PEM
2	EA	JAMB WEATHERSTRIPPING	2815M	628	PEM
1	EA	HEAD WEATHERSTRIPPING	2891S	628	PEM

HARDWARE SET 4 – PESTICIDE STORAGE DOOR 02

3	EA	HINGES	TA2714 4.5 X 4.5	652	MCK
1	EA	STOREROOM	45H7D 15S	630	BEST
1	EA	CLOSER w/STOP	CPS7500	689	NOR

HARDWARE SET 5 – GREENHOUSE BAY DOOR 03

BY GREENHOUSE MANUFACTURER – SEE SECTION 13 34 10

	EA	HINGES	AS REQUIRED		
1	EA	OFFICE	45H7AT	630	BEST
1	EA	CLOSER	7500	689	NOR

THRESHOLD, SWEEP, AND SEALS AS REQUIRED TO MEET BIO-SAFETY REQUIREMENTS

HARDWARE SET 6 – GREENHOUSE BAY DOOR 04

BY GREENHOUSE MANUFACTURER – SEE SECTION 13 34 10

	EA	HINGES	AS REQUIRED		
1	EA	OFFICE	45H7AT	630	BEST
1	EA	CLOSER	7500	689	NOR

THRESHOLD, SWEEP, AND SEALS AS REQUIRED TO MEET BIO-SAFETY REQUIREMENTS

HARDWARE SET 7 – GREENHOUSE CIRCULATION EXTERIOR DOOR 05A

BY GREENHOUSE MANUFACTURER – SEE SECTION 13 34 10

	EA	HINGES	AS REQUIRED		
1	EA	RIM EXIT	98L-NL	626	VON
2	EA	CYLINDER	AS REQUIRED	626	BEST
1	EA	CLOSER w/STOP	CPS7500	689	NOR
1	EA	EXIT ALARM	ES4300A-K4	-	DET
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		

THRESHOLD, SWEEP, AND SEALS AS REQUIRED TO MEET BIO-SAFETY REQUIREMENTS

HARDWARE SET 8 – GREENHOUSE DOOR 05B

BY GREENHOUSE MANUFACTURER – SEE SECTION 13 34 10

	EA	HINGES	AS REQUIRED		
1	EA	STOREROOM	45H7D 15S	630	BEST
1	EA	CLOSER	P7500		

THRESHOLD, SWEEP, AND SEALS AS REQUIRED TO MEET BIO-SAFETY REQUIREMENTS

HARDWARE SET 9 – UTILITY CHASEWAY DOOR 06

3	EA	HINGES	T4A3386 NRP 4.5 X 4.5	630	MCK
1	EA	RIM EXIT ONLY	98EO	626	VON
1	EA	CLOSER w/STOP	CPS7500	689	NOR
1	EA	THRESHOLD	252x3FG	628	PEM
1	EA	SWEEP	315CN	628	PEM
2	EA	JAMB WEATHERSTRIPPING	2815M	628	PEM
1	EA	HEAD WEATHERSTRIPPING	2891S	628	PEM
1	SET	ADHESIVE SEALS	S88	BLK	PEM
1	SET	SECURITY ASTRAGAL	353 x P491 INSERT	628	PEM
1	EA	DRIP CAP	346C	628	PEM

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Glass for glazed fixed windows.
   2. Glazing sealants and accessories.

B. Related Requirements:
   1. Section 08 51 13 “Aluminum Windows”
   2. Section 08 11 13 “Hollow Metal Doors and Frames”
   3. Section 07 92 00 “Joint Sealants”

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference:
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.
   1. Insulating glass.

C. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturers of insulating-glass units with low-E coatings, glass testing agency, and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For insulating glass and glazing sealants, for tests performed by a qualified testing agency
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Install glazing in mockups specified in Section 084413 "Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   2. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers and Fabricators: Specifications herein are based on glass and materials manufactured or fabricated by the following companies. Not all firms listed manufacture or fabricate all the items specified herein. However, to ensure consistent quality of appearance and performance, provide each type or kind of glass or material from a single source. Manufacturers for specialty products are listed within the specification to establish a particular type, color, pattern, etc.
   1. Manufacturers
      a. AGC FLOAT GLASS NORTH AMERICA
      b. PPG
      c. GUARDIAN INDUSTRIES
      d. PILKINGTON NORTH AMERICA
   2. Fabricators
      a. VIRACON

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
   2. Design Snow Loads: As indicated on Drawings.
   3. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
   4. Maximum Lateral Deflection: As indicated on Drawings.
   5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
   1. Large-Missile Test: For glazing located within 30 feet of grade.
   2. Small-Missile Test: For glazing located more than 30 feet above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: "Glazing Manual."
   2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
   3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
   4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC. VIN code shall provide detailed information including, but not limited to, insulating glass unit thickness, size, substrate, print, heat treatment and manufacture date.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
   1. Minimum Glass Thickness for Exterior Lites: As indicated on drawings.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

B. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:
   1. Polyvinyl butyral interlayer.
   2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
   3. Ionomeric polymer interlayer.
   4. Cast-in-place and cured-transparent-resin interlayer.
   5. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
   1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
   2. Spacer: Extruded thermoplastic warm edge spacer with argon.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Colors of Exposed Glazing Sealants: Match Government's samples

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers:
a. DOW CORNING
b. GE
c. TREMCO
2. Applications: where one or more porous bond surfaces are contacted.

C. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers:
a. BOSTIK CONSTRUCTION PRODUCTS
b. DOW CORNING
c. GE
d. PECORA
e. TREMCO
2. Applications: where only non-porous bond surfaces are contacted.

D. Weather Seal: High Performance, neutral, one part, natural-curing, silicon sealant, joint movement +/- 50, complying with ASTM C1184 and ASTM C 920, Type S, Grades NS, Class 50, Use NT, G,A and O
1. Manufacturers:
a. DOW Silicones Corporation, DOWSIL 795 Silicone Building Sealant
b. GE Silicones, SCS 9000 SilPruf

E. 4 sided structural seal (SSG): High Performance, neutral, one part, natural-curing, silicon sealant, joint movement +/- 50, complying with ASTM C1184 and ASTM C 920, Type S, Grades NS, Class 50, Use NT, G,A and O
1. Manufacturers:
a. DOW Silicones Corporation, DOWSIL 795 Silicone Building Sealant
b. GE Silicones, SCS 9000 SilPruf

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Thermoplastic with integrated desiccant and polyisobutylene (PIB) that is chemically bonded to the glass and the secondary silicone sealant.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
      a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 INSULATING GLASS SCHEDULE

A. Glass Type IG-1: Low-E-coated, clear insulating glass.
   1. Basis-of-Design Product: Viracon VNE1-63
   2. Overall Unit Thickness: 1 inch
   3. Minimum Thickness of Each Glass Lite: 1/4 inch
   4. Outdoor Lite: Fully tempered float glass.
   5. Interspace Content: Air.
   6. Indoor Lite: Fully tempered float glass.
   7. Low-E Coating: Pyrolytic on #2 surface.
   8. Winter Nighttime U-Factor: 0.30 maximum.
   9. Summer Daytime U-Factor: 0.27 maximum.
   10. Visible Light Transmittance: 47 percent minimum.
   11. Solar Heat Gain Coefficient: 0.31 maximum.
   12. Safety glazing required.

END OF SECTION 08 80 00

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board.

B. Related Requirements:
1. Section 05 40 00 “Cold Formed Metal Framing” for stud walls and roof joists at new utility chaseway.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Mold-resistant gypsum board.
2. Glass-mat gypsum sheathing board.
3. Joint treatment materials.
4. Acoustical sealant.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers:
   a. Basis of Design: USG Eco-Smart Mold Tough Firecode X
   b. National Gypsum
   c. Georgia Pacific
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 EXTERIOR GYPSUM BOARD

A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Manufacturers:
   a. USG Securock® Brand UltraLight Glass-Mat Sheathing, Type X
   b. National Gypsum
   c. Georgia Pacific
2. Core: 5/8 inch (15.9 mm), Type X.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet
2. Shapes:

    a. Cornerbead.
    b. L-Bead: L-shaped; exposed long flange receives joint compound.
    c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    d. Expansion (control) joint.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc
2. Shapes:

    a. Cornerbead.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:
1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Acoustical Sealant: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pecora Corporation.
   b. Tremco Incorporated.
   c. USG Corporation.

2. Sealant to have a VOC content of 250 g/L or less.

D. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on drawings and with product types on Drawings and herein specified.

B. Single-Layer Application:

1. On partitions/walls, apply gypsum panels vertically parallel to framing, or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

2. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Government for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. U-Bead: Use at exposed panel edges.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 3: Where indicated on Drawings
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 91 23 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Surface preparation and the application of paint systems on interior substrates.

2. Surface preparation and the application of paint systems on metal doors and frames.

3. Surface preparation and the application of paint systems on exterior concrete.

B. Related Requirements:

1. Section 04 22 00 “Concrete Unit Masonry”

2. Section 05 21 00 “Steel Joist Framing” and 05 31 00 “Steel Decking” – exposed ceiling structure to be painted.

3. Section 08 11 13 “Hollow Metal Doors and Frames”

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Government will select one surface to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Government will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Government at no added cost to Government.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Government specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provided they meet project requirements, the following manufacturers will be considered acceptable:
1. Glidden Professional
2. Sherwin Williams
3. Benjamin Moore

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

D. Colors: As indicated in a color schedule.

2.3 PRIMERS

A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

B. Interior Latex Primer for Wood: Waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on interior wood subject to extractive bleeding.

C. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

D. Surface-Tolerant Metal Primer: Corrosion-resistant, solvent-based metal primer formulated for use on structural steel and metal fabrications that have been minimally prepared.

E. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

F. Water-Based Bonding Primer: Water-based-emulsion primer formulated to promote adhesion of subsequent specified coatings.

G. Epoxy Primer for metal doors and frames: Epoxy, anti-corrosive, for metal.

2.4 FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss and Sheen Level: Manufacturer's standard flat finish.

B. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

C. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
   1. Gloss Level: Manufacturer's standard semigloss finish.

D. Epoxy Gloss for intermediate coat for metal doors and frames.

E. Pigmented Polyurethane, Semigloss for finish coats for metal doors and frames.

F. Texture Coating: High build, 100% acrylic latex coating formulated to seal, and protect existing concrete.
   1. Alkaline resistant coating, one coat system
   2. Texture: Smooth
   3. Manufacturers:
      a. Sherwin Williams; Product: Modac
      b. Textured Coatings of America
      c. Benjamin Moore

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Government may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Government, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI INT 3.1A:
   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
      1) Benjamin Moore / Ultra Spec Interior/Exterior Acrylic High-Build Masonry Primer
      2) PPG / Dulux Gripper Interior/Exterior Universal Acrylic Primer/Sealer
      3) Sherwin Williams / PrepRite ProBlock Interior/Exterior Latex Primer/Sealer
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
      1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Gloss
      2) PPG / Dulux Lifemaster Interior 100% Acrylic Semi-Gloss
      3) Sherwin Williams / Pro Tech Interior Latex Semi-Gloss Enamel

B. CMU Substrates:

1. Latex System MPI INT 4.2A:
   a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
      1) Benjamin Moore / Ultra Spec Hi-Build Masonry Block Filler
      2) PPG / Dulux X-Pert Interior/Exterior Latex Blockfiller
      3) Sherwin Williams / PrepRite Interior/Exterior Block Filler
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
      1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Gloss
      2) PPG / Dulux Lifemaster Interior 100% Acrylic Semi-Gloss
      3) Sherwin Williams / Pro Tech Interior Latex Semi-Gloss Enamel

C. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q:
    a. Prime Coat: Shop primer specified in Section where substrate is specified.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
        1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Gloss
        2) PPG / Dulux Lifemaster Interior 100% Acrylic Semi-Gloss
        3) Sherwin Williams / Pro Tech Interior Latex Semi-Gloss Enamel

D. Steel Door and Frame Substrates (interior and exterior doors):

1. Pigmented Polyurethane over Epoxy System:
    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    b. Intermediate Coat: Epoxy, gloss.
    c. First and Second Topcoat: Pigmented polyurethane, semigloss.

E. Galvanized-Metal Substrates:

1. Latex System MPI INT 5.3J:
    a. Prime Coat: Primer, galvanized, water based, MPI #134.
        1) Benjamin Moore / Ultra Spec HP Acrylic Metal Primer
        2) Sherwin Williams / Pro Industrial Pro-Cryl Universal Primer
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
        1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Gloss
        2) PPG / Dulux Lifemaster Interior 100% Acrylic Semi-Gloss
        3) Sherwin Williams / Pro Tech Interior Latex Semi-Gloss Enamel
2. Water-Based Dry-Fall System MPI INT 5.3H:
    a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
    b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
        1) Behr Paint / Pro Dryfall
        2) Diamond Vogel / Luminance 300 Latex Dri-Mist Flat
        3) PPG / Glidden Spraymaster Interior DTM Latex Dryfall Flat

F. Gypsum Board Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:
    a. Prime Coat: Primer sealer, latex, interior, MPI #50.
        1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Primer Sealer
        2) PPG / Glidden Professional PVA Drywall Interior Primer and Sealer
        3) Sherwin Williams / Pro Tech Interior Drywall Surfacer Primer
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat (Ceilings): Latex, interior, flat (MPI Gloss Level 1), MPI #53.
        1) Benjamin Moore / Ultra Spec 500 Interior Flat Finish
        2) PPG / Glidden Professional Ultra-Hide 250 Interior Acrylic Flat
        3) Sherwin Williams / Super Paint Interior Latex Flat
    d. Topcoat (Walls): Latex, interior (MPI Gloss Level 3), MPI #52.
        1) Benjamin Moore / Ultra Spec 500 Interior Eggshell
        2) PPG / PPG Paints Speedhide Interior Satin Acrylic Latex
        3) Sherwin Williams / Pro Tech Interior Eggshell Paint
2. High-Performance Latex System MPI INT 9.2B:
    a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Primer Sealer
2) PPG / Glidden Professional PVA Drywall Interior Primer and Sealer
3) Sherwin Williams / Pro Tech Interior Drywall Surfacer Primer

b. Intermediate Coat: Latex, interior, high performance, matching topcoat.

c. Topcoat: Latex, interior, high performance (MPI Gloss Level 3), MPI #139.

1) Benjamin Moore / Ultra Spec 500 Waterborne Interior Eggshell
2) PPG / Glidden Diamond Interior Paint + Primer Eggshell
3) Sherwin Williams / ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel

G. EXTERIOR CONCRETE SUBSTRATES (existing lab building poured in place concrete walls)

1. Vertical (Nontraffic) Surfaces:

a. High Build System on previously coated surface:

1) Intermediate Coat: 1 coat MODAC Acrylic Texture Coating
2) Topcoat: Same as intermediate coat

END OF SECTION 09 91 23

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.

B. Government-Furnished Material: Hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated. Coordinate requirements with the Government.
   1. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.

B. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Government.

   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

   1. Mounting Height: Top of fire extinguisher to be as shown on drawings.

END OF SECTION 10 44 16

SECTION 12 35 53.13 - METAL LABORATORY CASEWORK

1.1 SUMMARY

A. Section Includes:

1. Metal laboratory casework.
2. Auxiliary cabinets.
3. Countertops.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring laboratory casework.

1.2 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory casework.

1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
2. Indicate types and sizes of casework.
3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations and types of service fittings.
6. Include details of utility spaces showing supports for conduits and piping.
7. Include details of support framing system.
8. Include details of exposed conduits, if required, for service fittings.
9. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and laboratory equipment.
10. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For casework finishes and materials requiring color selection.

E. Samples for Initial Selection: For casework finishes and materials requiring color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Test Reports:

1. Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard.
2. Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface material with requirements specified for chemical and physical resistance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of casework finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 M.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Field Measurements: Where laboratory casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

A. Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.

B. Basis of Design Manufacturer: Mott Manufacturing Ltd. or equivalent

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 016000 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system are to withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

1. Support Framing System: 600 lb/ft. (900 kg/m)
2. Work Surfaces: 160 lb/ft. (240 kg/m)
3. Shelves: 40 lb/sq. ft. (200 kg/sq. m)
4. Component Importance Factor: 1.0
5. Base Cabinet Load (Including Countertop and Load on Countertop): 320 lb/ft. (480 kg/m).
6. Wall Cabinet (Upper Cabinet) Load: 160 lb/ft. (240 kg/m).

2.3 CASEWORK, GENERAL

A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."

B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 METAL LABORATORY CASEWORK

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.

B. Nominal Metal Thickness:

1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch (1.21 mm). Except for flammable liquid storage cabinets, bottoms may be 0.036 inch (0.91 mm) if reinforced.

2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch (0.91 mm) except 0.048 inch (1.21 mm) for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches (900 mm) long.
3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch (1.52 mm).
4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch (1.90 mm).
5. Leveling and Corner Gussets: 0.105 inch (2.66 mm).

2.5 CABINET HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with anti-friction bearings and rounded tips. Provide two for doors 48 inches (1200 mm) high or less and three for doors more than 48 inches (1200 mm) high.

C. Locks: Cam or half-mortise type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281. Coordinate keying with Government.

2.6 COUNTERTOPS

A. General: Provide laboratory countertops as indicated on Drawings.

B. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

2.7 METAL CABINET FABRICATION

A. General: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt- and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch (1.5 to 2.4 mm).

B. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

C. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.

D. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.

2.8 METAL CABINET FINISH

A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 M. Acceptance level for chemical spot test is to be no more than for Level 3 conditions.
2. Colors for Metal Laboratory Casework Finish: As selected by Government from manufacturer's full range.

2.9 COUNTERTOP FABRICATION

A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch (25 mm).

B. Stainless Steel:

1. Countertops: Made from stainless steel sheet, not less than 0.062-inch (1.59-mm) nominal thickness, with No. 4 satin finish.

   a. Extend top down 1 inch (25 mm) at edges with a 1/2-inch (13-mm) return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
   b. Form backsplash coved to and integral with top surface.
   c. Provide raised (marine) edge around perimeter of countertops containing sinks.
   d. Pitch countertops that contain sinks two ways to sink without channeling or grooving.
   e. Factory punch holes for service fittings.
   f. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to ensure rigidity without deflection.
   g. Weld shop-made joints.
   h. Where field-made joints are required, provide hairline butt joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
   i. Where stainless steel sinks and cup sinks occur in stainless steel countertops, factory weld into one integral unit.
   j. After fabricating and welding, grind surfaces smooth and polish to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

2. Shelves: Made from stainless steel sheet, not less than 0.050-inch (1.27-mm) nominal thickness, with No. 4 satin finish. Weld shop-made joints. Fold down front edge 3/4 inch (19 mm); fold up back edge 3 inches (75 mm).

   a. Provide integral stiffening brackets, formed by folding up ends 3/4 inch (19 mm) and welding to upturned front and back edges.

b. After fabricating, grind welds smooth and polish to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
c. Apply 1/8-inch- (3-mm-) thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches (400 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than two fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches (400 mm) o.c.

E. Install hardware uniformly and precisely.

F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.

B. Fastening:

1. Secure countertops with low profile wall brackets and stainless steel legs as required.

C. Provide holes and cutouts required for service fittings.

3.4 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.

B. Semiflush Installation of Stainless Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.

3.5 INSTALLATION OF SERVICE FITTINGS

A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.

B. Install fittings in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.6 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Government.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION 12 35 53.13

SECTION 13 34 13.13 – GLAZED STRUCTURES – GREENHOUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Section 01 23 00 – Alternates.
B. Section 03 30 00 – Cast-In-Place Concrete: Cast-in-place concrete foundations, slabs, and walls.
C. Section 07 92 00 – Joint Sealants
C. Division 22 – Plumbing
D. Division 23 – HVAC
E. Division 26 – Electrical
F. Division 27 – Communications
G. Division 28 – Electronic Safety and Security

1.02 REFERENCES

A. AAMA 611 – Voluntary Specification for Anodized Aluminum.
B. ASTM A 36 / A 36M – Standard Specification for Carbon Structural Steel.
C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
D. ASTM B 308/b 308M – Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
E. ASTM C 864 – Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
F. AWS D1 – Structural Welding Code.
G. NGMA - National Greenhouse Manufacturer's Association Standards and Guidelines.

1.03 SUMMARY

A. Furnish and install the BSL-2P (Plant Biosafety Level 2) compliant greenhouse as hereinafter specified and shown on the drawings. Dimensions shown are nominal and may vary according to manufacturers' standards provided the net square foot area covered is not less than that shown.
B. Basis of Design: Ludy Greenhouses Steel, Peak-Roof R/S Series II.
   a. Alternate Manufacturers: as acceptable to the Government.
   b. Reference Section 01 25 00 – Substitution Procedures for the requirements to submit documentation for any proposed alternate manufacturer. Substitution request must be submitted not less than 21 calendar days prior to the bid due date. No substitution shall be allowed without the Government's written acceptance. No substitutions shall be acceptable past the days noted above.
C. Bid Options as follows:
   a. BID OPTION #2: ADD RETRACTABLE SHADE/HEAT RETENTION CURTAIN SYSTEM AT GREENHOUSE ROOF. REFERENCE SHEET A400.
   b. BID OPTION #4: ADD AN INCREASE IN THE GREENHOUSE BUILDING HEIGHT BY 4'-0". THIS SHALL INCLUDE ALL BUILDING SYSTEMS TO BE EXTENDED TO PROVIDE THIS INCREASE TO THE INTERIOR CLEAR HEIGHT ALSO AS NOTED ON DRAWINGS - EXTERIOR ELEVATIONS AND BUILDING SECTIONS, SHEETS A400 AND A600.

1.02 SCOPE

A. The completed greenhouse and connecting headhouse spaces shall comply with the USDA's BSL-2P requirements and with USDA APHIS containment facility guidelines for fungal plant pathogens.
B. The greenhouse building structure shall be a delegated design by the Contractor.

C. This section of the specifications does not specifically list the requirements of the greenhouse concrete foundations or concrete floor slabs, plumbing, electrical (either power supply or control wiring), utility connections. Reference the relevant additional technical specifications in this Project Manual for additional requirements. The greenhouse and all MEP and other building systems shall be integrated to provide a complete greenhouse and headhouse building to operate as intended as shown in the drawings and listed in these specifications.

D. Furnishing and erect the greenhouse superstructure including all glazing, doors & door hardware systems. Incorporate all ventilation systems as shown in the drawings and/or hereinafter described.

E. The Greenhouse Manufacturer shall provide both the manufacturing and the complete field installation of the Greenhouses. The Greenhouse fabrication and installation on site shall be the responsibility of one single Greenhouse Manufacturer only.

F. Coordination of the foundation installation with the approved greenhouse shop drawings shall be made prior to installation of concrete foundations and slabs. Approved greenhouse shop drawings shall be used to make all foundation installations. Verify all dimensions prior to commencing with the work since the greenhouse shop drawing dimensions may vary slightly from the contract drawings to accommodate manufacturer's actual dimensions, but total area of the greenhouses shall not be less than 98% of that shown in the drawings. Net SF area of the greenhouses shall not be less than shown in the CDs.

G. All headhouse and greenhouse spaces shall comply with the USDA's BSL-2P requirements and with USDA APHIS containment facility guidelines for fungal plant pathogens. The greenhouse building structure shall be a delegated design by the Contractor. The greenhouse and all MEP and other building systems shall be integrated to provide a complete greenhouse and headhouse building to operate as i

1.03 PLANS AND SUBMITTALS

a. A complete set of shop drawings including details shall be submitted by the greenhouse manufacturer for approval prior to fabrication. Submittals shall also include structural calculations and data on all equipment, glazing and doors supplied by greenhouse manufacturer. Submittals shall meet structural requirements of applicable local or state building codes. Plans and calculations shall be signed and sealed by the licensed structural engineer.

   a. Product Data: Manufacturer's product illustrating the greenhouse system, performance data and visual appearance. Provide at a minimum:
      i. Product data on all major greenhouse systems and components including the glazing, aluminum framing system for the glazing, and structure.
      ii. Product data for light transmission and light spectrum performance of the glazing.
      iii. Thermal performance of the glazing and aluminum framing system for the glazing and completed glazed exterior enclosure.
      iv. Other components to be utilized including ventilation, flashing and counter flashings integrated with the glazed enclosure, doors and frames and hardware.
   b. Floor and Roof Plans shall be submitted at not less than 3/8" = 1'-0" scale. Show that all ventilation and related MEP systems are integrated with Greenhouse construction.
   c. Building Sections at both the longitudinal and transverse directions at not less than 3/8" = 1'-0" scale. Show all greenhouse enclosure components and systems. Show that all ventilation and MEP systems integrated with Greenhouse construction.
   d. Details of all significant components of the Greenhouse. Include foundations (including protective flashing at foundation wall insulation as detailed on drawing), floor slabs and adjacent construction to show how Greenhouses details are integrated with these. Details shall be at not less than one- half full size.
   e. Door and hardware schedules elevations and details.

f. The Delegated Design and structural calculations shall be made by a structural engineer licensed in the State of Illinois and shall have prior successful experience with not less than four (4) similar greenhouse projects. Submit these engineer's qualifications.

1.04 ERECTION OF GREENHOUSE

A. The greenhouse shall be erected by the greenhouse manufacturer or by the Greenhouse manufacturer's qualified greenhouse specialty contractor provided by the manufacturer. The greenhouse installer shall have at least five years experience in building greenhouses of the type specified.

B. The Greenhouse installer shall inspect and survey the site conditions including concrete foundations, slabs and adjacent construction prior to installation of the Greenhouse to ensure that these are acceptable prior to installation of the Greenhouses. The installer shall not proceed with the work until any unacceptable conditions are corrected. The installer shall then provide their written acceptance of the conditions.

B. Grouting: after the greenhouse installer has placed the wall glazing framing, provide the necessary materials and labor to grout between the wall and the poured in place concrete sill as necessary to eliminate any discrepancies between the two and produce a finished joint.

PART 2 - MATERIALS

2.01 STANDARD OF QUALITY

A. All structures shall be designed to requirements of state/local building codes.

B. Greenhouse structure(s) shall be designed in accordance with current AISI Specifications for Design of Cold - Formed Steel Structural Members and AISC Specifications for Structural Steel Buildings. Greenhouse structure(s) shall include sufficient bracing for the resistance to wind forces. Bottom chord members as well as other truss members shall be adequate to resist compressive loads produced by horizontal wind loads and roof uplift produced by wind.

2.02 MATERIALS AND COMPONENTS

A. Structures shall be designed and detailed according to accepted engineering practice. Framing shall consist of trusses, hot dip galvanized after fabrication, on 12'-0" centers spanning the full width of the structure with a 6/12 roof pitch. No castings, either of aluminum or aluminum alloy, shall be permitted for joining structural members at joints subject to stress in which tensile strength is a factor.

B. Primary framing shall be 50,000 P.S.I. yield strength steel.

1. Trusses shall be of 2" square steel tube (or heavier) with welded plate connections and hot dip galvanized after fabrication. Trusses shall ship from factory assembled in no more than two pieces ready to attach at the post connection. All tolerances shall be held to an absolute minimum in order to secure proper fit of the steel members.
2. Truss support posts shall be 4" square steel tube (or heavier) furnished and placed at all truss bearing locations. Aluminum cast or aluminum alloy connectors are not acceptable.
3. Trusses shall be connected to the side wall post by a welded post top connector hot dip galvanized after fabrication.

4. Galvanized steel roof purlins, of size required, shall be prefabricated before shipment from greenhouse manufacturer.
5. Provide all other structural members required to complete the framework of the greenhouse that are not mentioned above such as; bracing, clips, lugs, girts, and fasteners.

C. Secondary framing shall be extruded aluminum, members such as roof bars, ridge, sash, etc. Members shall be mill finish, with appropriate heat treatment of alloy 6063-T6 or 6063-T5. Sheet aluminum shall be of alloy 3003-h14.

2.03 FASTENERS

A. All structural connections shall be attached with corrosion resistant hot dip galvanized (ASTM-307 bolts) or stainless steel fasteners. All aluminum to aluminum connections shall have aluminum or stainless steel fasteners. All screws and self tapping screws shall be stainless steel or hot dip galvanized.

2.04 GUTTERS

A. Gutters shall be 12 gauge steel fabricated for connection at the post tops, and also to accept roof and side wall glazing closures. Gutters shall be hot dip galvanized after fabrication. Outlet tubes shall be provided where indicated on the drawings.

2.05 EXPANSION AND CONDENSATION CONTROL

A. All members shall handle expansion individually to prevent an accumulation of expansion in one direction from several members. Roof glazing bars shall incorporate condensation channels to conduct primary condensation to disposal points at gutter.

2.06 GLAZING

A. ACRYLIC Double-skinned sheets - 16mm ACRYLITE® ALLTOP HIGH IMPACT UV TRANSMITTING or equivalent. Material shall be glazed into an extruded aluminum gasketed system approved by the acrylic manufacturer and designed to provide for expansion and contraction.

b. POLYCARBONATE Double-skinned sheets (at greenhouse side of interface with Headhouse and Utility Chaseway) - 16mm material shall be glazed into an extruded aluminum glazing system approved by the Polycarbonate manufacturer. Supplementary materials shall be compatible with Polycarbonate sheets. Expansion and contraction shall be provided for. Polycarbonate sheets shall have UV protection.

2.07 RETRACTABLE SHADE/HEAT RETENTION CURTAIN SYSTEM – BID OPTION #2

A. General

a. Independently motorized Shading, Cooling and Heat Retention Curtain System(s) designed for size of greenhouse as shown on the drawings.
   i. Basis-of-Design: PowerPull by Wadsworth Controls.

b. Curtains are to travel simultaneously from truss to truss and have a peaked or “roofline” profile with a flat top.

c. Support lines with clear, low friction, polyester lines spaced 16” o.c.

d. System to include extruded aluminum seal angles at each truss location designed to accept rubber seals for use in photoperiod (black-out) systems and adjustable clips to secure support and anti-billowing lines to the seal angle while maintaining straight lines down the length of the greenhouse.

e. Shade/Heat retention fabric Basis-of Design: Bonar Product Line

i. Phormitex 77B Polyester & Aluminum - 75% shade factor / 68% energy savings – final fabric shade fabric to be selected by the Government from full range.

B. Motors and Controls
a. System to be operated by one motor.
b. Motor is to be U.L. or CSA approved.
c. Primary and backup limit switches for each travel direction to be integrally mounted into the motor. External limit switches are not acceptable.
d. Motor to be controlled by greenhouse environmental control system.

C. Cable Drive System
a. Drive cable to be 3/32” diameter 7 x 19 stainless steel.
b. Drive cables are to be of a continuous length without any splices.
c. Curtain system to be cable driven using composite drums (two drums per drive cable) and return pulleys. No metal drums or bare drive shaft cable wrapping will be allowed. Push-Pull (rack & pinion) systems are not an acceptable substitution.

D. System Hardware
a. All rotating components, i.e. bearing brackets and pulleys are to utilize pre-greased double sealed ball bearings.
b. All hardware is to be corrosion protected by either galvanizing or plating.

E. System Sealing
a. Proper sealing of the curtain system at the trusses is to be accomplished using fixed fabric skirts as energy seals.
b. Fixed fabric panels are to be wrapped and stapled around a 1 x 7 coated cable. Upper wrapped wire of sidewall seal to be capped with a smooth plastic wire guard designed to reduce wear between the above Shade/Heat retention Curtain and the Seal Fabric. Wire guard to travel the length of the greenhouse.
c. All curtains are to come precut with ends serged to prevent unraveling of material.

2.08 DOORS, FRAMES, AND HARDWARE
A. Greenhouse Doors and Frames:
a. Provide storefront doors as indicated on drawings and spec. section 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

B. Greenhouse Door Hardware as indicated on drawings and spec. section 08 71 00 DOOR HARDWARE.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Drilling and setting of anchor bolts is to be by Greenhouse Manufacturer.

B. Install entire system and all components in strict accord with manufacturer's recommendations.

C. Greenhouse Manufacturer is responsible for all unloading of greenhouse materials, systems, equipment and to provide any lift or installation equipment required.

D. Environmental Control System Installation: Contractor to coordinate the following:

a. Coordinate with the greenhouse environmental controls supplier and other trades providing and installing the greenhouse environmental control panel(s), communication wires and sensor wires conduits, power wiring, control wiring to the control panel, and/or if a computer is provided, from computer to greenhouse control panel including low voltage wiring.

b. Coordinate the load wiring and load terminations in the control panel, as well as limit switch wiring to the operable vent(s) and or shade/heat retention curtain system(s) requirements.

3.04 FLASHING

A. Provide and install all flashing and counterflashing required for a air and water-tight construction and to integrate with the adjacent construction. Drawings establishing flashing lines shall be furnished by the Greenhouse Manufacturer. All flashing and counter-flashing shall be minimum 1/16" thick prefinished or anodized aluminum to match the Greenhouse system or the equivalent non-magnetic stainless steel.

3.05 INSTRUCTION

A. Provide a minimum of (2) two site visits by the Greenhouse Manufacturer project management or technical representative,

B. Greenhouse Manufacturer personnel in combination with the greenhouse environmental controls personnel shall instruct Government, on site, on the use and operation of the greenhouse, including greenhouse systems and equipment. Provide not less than one (1) four-hour training session for Government staff. Conduct the training referencing the O&M manuals listed below.

C. Greenhouse Manufacturer shall supply the project with complete sets of Operation & Maintenance manuals both in three ring binders (4) and in CD format. Maintenance manuals shall include all equipment data and product literature including all periodic maintenance requirements.

3.06 WARRANTIES

A. Greenhouse Manufacturer shall provide a one (1) year warranty on materials and workmanship from date of substantial completion. Any greenhouse warranty item within the warranty period shall be directed to and be the direct responsibility of the Greenhouse Manufacturer, including that of its material suppliers, vendors and subcontractors.

B. Written warranty conforming to the above paragraph to be submitted as a part of the approval drawing submittal package.

END OF SECTION 13 34 13.13

SECTION 22 05 00 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required for a finished and working system.

C. Scope of Work:

D. Plumbing Work shall include, but is not necessarily limited to:

1. Furnish and install all items listed in the Plumbing Material List.

2. Extend new domestic water from the South Wing penthouse to the new building. Insulate all piping as specified.

3. Furnish and install a complete domestic water piping system including cold, hot, and hot water circulating piping within the building. Insulate all piping as specified.

4. Extend deionized water from the South Wing penthouse to the new building.

5. Provide concrete pad, fencing, bollards and CO2 tank and underground C02 piping, including pipe sleeve for the entire length of underground piping, to the new building and to manifolds as shown on drawings. All of this work shall be included under Bid Alternate #5.

6. Furnish and install water softener.

7. Furnish and install water heater.
8. Furnish and install makeup water connection to hydronic heating system including reduced pressure principle type backflow preventer.

9. Furnish and install complete sanitary sewer and vent system including waste water holding tanks, control valves, high water level alarm panels, and all associated wiring in conduit.

10. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

11. Provide new floor drains and associated plumbing within the existing mechanical room including all required floor cutting and patching.
12. Include all demolition work as shown on the drawings.
13. Testing, Adjusting, and Balancing Work: Refer to Section 23 05 00 "Basic HVAC Requirements".

1.3 PRODUCTS FURNISHED BY OTHERS

A. The Government will supply the following items for installation and/or connection by the Contractor:

1. Electric autoclave and associated reverse osmosis equipment.

B. The Government will supply manufacturer's installation data for this equipment.

C. This Contractor shall make all plumbing system connections shown on the drawings or as required for fully functional units.

D. This Contractor is responsible for all damage to equipment furnished by others caused during installation.

1.4 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Contracting Officer's Representative, shall be scheduled with the Contracting Officer's Representative. It may be necessary to schedule such work during unoccupied hours. The Contractor Officer's Representative reserves the right to determine when restricted construction hours will be required.

1.5 ELECTRICAL WORK

A. Definitions:

1. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
2. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
3. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
4. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

    a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

5. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
6. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The Contractor is responsible for all electrical work required for items such as temperature controls, equipment, fans, and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for plumbing systems, is the responsibility of the Contractor.
2. The Contractor shall provide complete electrical power/controls wiring diagrams and designate the terminal numbers for correct wiring of all equipment.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring for plumbing equipment and devices unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. The Contractor shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

    a. Light fixtures.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical busduct.
    d. Sheet metal.
    e. Electrical cable trays, including access space.
    f. Electrical conduits and wireway.

C. Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all plumbing equipment and devices.
2. Provides all combination starters, manual starters, and disconnect devices required for plumbing equipment.
3. Installs and wires all plumbing equipment and devices.
4. This Contractor is responsible for the coordination of all utilities. If any field coordination conflicts are found, the Contractor shall be responsible for determining a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

   a. Mechanical equipment, ductwork, plumbing piping, hydronic piping, steam and steam condensate piping, etc.
   b. Electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, etc.
   c. Technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, etc.
   d. Maintenance clearances and code-required dedicated space shall be included.
   e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify the Government of the maximum clearance which can be maintained. Failure to comply will result in modifications at the Contractor's expense.

   a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.

3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The Contractor shall participate in the coordination drawing process.
2. The Contractor shall prepare a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.

3. The Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

4. Government Representative will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver. Blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Government.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).
      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Government Representative for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Government Representative. The Government Representative will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. The Contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The Contractor will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The Contractor will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Government Representative reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Government Representative.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
   b. Potential layout changes shall be made to avoid additional access panels.

c. Additional access panels shall not be allowed without written approval from the Government Representative at the coordination drawing stage.
d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Government Representative.
e. When additional access panels are required, they shall be provided without additional cost to the Government Representative.

10. Complete the coordination drawing process and obtain sign off of the drawings by the Contractor prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.7 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Government prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Government will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Peoria, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of the USDA.
3. Conform to all State Codes.
4. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
5. If there is a discrepancy between the codes and regulations and these specifications, the Government shall determine the method or equipment used.
6. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Government in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.

7. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Government.
8. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
9. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Government.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Government.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.
    b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

1.8 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings. Refer to Division 1 for submittal procedures.

1. Submittals List:

Referenced Specification Section	Submittal Item
22 05 03	Fire Seal Systems
22 05 29	Hangers and Supports
22 05 53	Plumbing Identification
22 07 19	Plumbing Pipe Insulation
22 09 00	Instrumentation
22 10 00	Plumbing Piping Systems and Valves
22 10 30	Plumbing Specialties
22 11 23	Domestic Water Pumps
22 40 00	Plumbing Fixtures

1.9 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Fire Seal Systems
2. Deionized Water Piping System

B. Contractor shall arrange for and obtain supplier's on-site inspections at proper times to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Government and include copies of Owner's Operation and Maintenance Manuals.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

1. Motor windings and ventilation openings.
2. Bearings.
3. Equipment Pipe and Accessories connection openings. (e.g. boiler connections, coil connections, etc.)

4. Starter and control cabinets.
5. Heat transfer coils.
6. Pump Seals.
7. Combustion burner and blower equipment (e.g. combustion air intake, combustion vent/flue, etc.)

C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Government that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.

D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Government. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.11 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Government.

1.12 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Government for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Government.

C. Warranty requirements shall extend to correction, without cost to the Government, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.13 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.14 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the first manufacturer is the basis for job design and establishes the quality.

B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Government not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website (https://call811.com/) or by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Government, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workers.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Government or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Government or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Government.

E. Fill and Backfilling:

1. Utilities Bedding: Lay underground utilities on minimum of 6" sand bedding. Compact bedding under utilities smooth, with no sharp edges protruding, to protect the utilities from puncture. Shape bedding to provide continuous support for bells, joints, and barrels of utilities and for joints and fittings.
2. Envelope Around Utilities to 6" Above Utilities: Place sand to a height of 6" over utilities in 6" layers. After connection joints are made, any misalignment can be corrected by tamping backfill around the utilities.
3. Backfill From 6" Above Utilities to Earthen Grade: Place all backfill materials above the utilities in uniform layers not exceeding 6" deep.

4. Backfill From 6" Above Utilities to Below Slabs or Paved Area: Where the sand fill and backfill will ultimately be under a building, floor or paving, each layer of backfill materials shall be compacted to 95% of the maximum density determined by AASHTO Designation T 99 or ASTM Designation D 698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T 99 or ASTM D 698 test.
5. Backfill Materials:

    a. Sand: Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
    b. Native Soil: Native soil materials may be used as backfill if approved by the Geotechnical Engineer. Native soils shall be free of rock or gravel larger than 3" in any dimension and shall be free of debris, waste, frozen materials, vegetation, high void content, and other deleterious materials. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

6. Water shall not be permitted to rise in unbackfilled trenches.
7. Dispose of excess excavated earth as directed.
8. Backfill all trenches and excavations immediately after installing utilities or removal of forms, unless other protection is provided.
9. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

F. Surface Restoration:

1. Where trenches are cut through existing graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 GOVERNMENT'S OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Government prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Government will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Government's review. This includes, but is not limited to:

   a. Pipe insulation is installed and fully sealed.
   b. Pipe wall penetrations are sealed.
   c. Pipe identification and valve tags are installed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Government finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Government may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Government so that the final observation can be scheduled.
4. It is understood that if the Government finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Government's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including drawings and specifications.
3. A report documenting the instructions given to the Government's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Government's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Government required prior to final payment approval.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Government's review and approval. The electronic copy shall be corrected as required to address the Government's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Government.
2. Approved O&M manuals shall be completed and in the Government's possession prior to Government's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Government.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. O&M file name: O&M.div22.contractor.YYYYMMDD
    b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Government with an approved copy of the O&M manual on flash drives with a key ring tag, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Government, three paper copies of the O&M manual shall be provided to the Government. The content of the paper copies shall be identical to the corrected electronic copy.
2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.
16. Government and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

3.6 INSTRUCTING THE GOVERNMENT'S REPRESENTATIVES

A. Adequately instruct the Government's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Government's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a video recording of instructions to the Government while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Government.

D. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Maintenance of equipment.
3. Start-up procedures for all major equipment.
4. Explanation of seasonal system changes.

5. Explanation of Government's Responsibilities to operate, maintain, and flush domestic water system (i.e., ASHRAE Standard 188).

E. Notify the Government of the time and place for the verbal instructions to be given to the Government's representative so a representative can attend if desired.

F. Minimum hours of instruction for each item shall be:

1. Plumbing systems and equipment - 4 hours

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Government prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Government's representatives for the mechanical and control systems.
2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Government for the Government to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Government is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Government on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Government for services required

that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. The following paragraphs supplement Division 1 requirements.

B. Maintain at the job site a separate and complete set of plumbing drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

D. Before completion of the project, a set of reproducible plumbing drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

F. Record changes daily and keep the marked drawings available for the Government's examination at any normal work time.

G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Government.

3.9 PAINTING

A. Paint all equipment that is marred or damaged prior to the Government's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.

C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Government the color preference and furnish this color.

E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

F. Paint all outdoor uninsulated steel piping the color selected by Government.

G. Paint all outdoor exposed piping, including roof vents, the color selected by Government.

H. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.
3. Color of paint shall be selected by architect.

3.10 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Government's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.11 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Government's designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Government's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.12 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractor shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

    a. Minimizing the amount of dust generated.
    b. Reducing solvent fumes and VOC emissions.
    c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
    d. Protect stored on-site and installed absorptive materials from moisture damage.

2. Request that the Government designate an IAQ representative.
3. Review and receive approval from the Government's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
5. Schedule activities that may cause IAQ conditions that are not acceptable to the Government's IAQ representative during unoccupied periods.
6. Request copies of and follow all of the Government's IAQ and infection control policies.
7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

3.13 UTILITY REBATE

A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.

1. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled, and valves tagged.
5. Government and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

Accepted by:

Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Government so that the final observation can be scheduled.

It is understood that if the Government finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Governments for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION 22 05 00

SECTION 22 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 - Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. 2021 International Building Code

J. NFPA 5000 - Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Section 22 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Government at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 CFM/sq. ft at both ambient temperature and 400F or smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Contractor, Firestopping Manufacturer's Representative, and the Contracting Officer's Representative.

1. Review foreseeable methods related to firestopping work.
2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Dow Corning Corp.
10. Fire Trak Corp.
11. International Protective Coating Corp.
12. HoldRite

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:

   a. F Rating = Floor/Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:

   a. F Rating = Floor/Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999

Penetrating Item	UL System No.
Multiple Penetrations	WL 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall/Floor Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Contracting Officer's Representative, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Government's Representative and manufacturer's factory representative. The Government's Representative shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the discretion of the Government's Representative and the Contractor's expense.

END OF SECTION 22 05 03

SECTION 22 05 29 - PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.

B. Equipment Bases and Supports.

C. Sleeves and Seals.

D. Flashing and Sealing of Equipment and Pipe Stacks.

E. Cutting of Openings.

F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

B. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

C. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices

D. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 22 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:
   1. Steel and Cast Iron:

      a. Hanger Rod Diameter:

         1) 2" and smaller: 3/8"
         2) 2-1/2" through 3-5/8": 1/2"
         3) 4" through 6": 1/2"
         4) 8": 5/8"

   2. Copper and Plastic Pipe:

      a. Hanger Rod Diameter:

         1) 2" and smaller: 3/8"
         2) 2-1/2") through 3-5/8": 1/2"
         3) 4") through 6": 1/2"
         4) 8": 5/8"

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas, including the greenhouse bays, shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

2.2 PIPE AND STRUCTURAL SUPPORTS

A. General:

   1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, -69, -89, and -127 (where applicable).
   2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

   3. Copper piping located in an exposed area, including indirect waste piping, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

      a. Products:

         1) nVent/M-Co Model #456

2) Eaton Fig. 3198HCT
3) Anvil Fig. CT138R

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 10 feet Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

   a. Products:

      1) Eaton Fig B3373 Series
      2) nVent 510 Series
      3) Anvil Fig. 90

2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

   a. Products:

      1) Mason RBA, RCA or RDA
      2) Mason BR

3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.

   a. Products:

      1) Pipeshields, Inc E1000, E1100, E1200, or E1300 (manufacturer to confirm based on pipe diameter and weight when in service)

4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65F to +275F.

3. Vertical cold pipe drops and rough-ins to fixtures shall be supported by insulated pipe clamps to prevent thermal bridging and condensation.
4. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
5. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

    a. Products:

        1) Anvil Fig. 160, 161, 162, 163, 164, 165
        2) Eaton Fig. 3160, 3161, 3162, 3163, 3164, 3165
        3) nVent Model 630, 631, 632, 633, 634, 635

6. Unless otherwise indicated, hangers shall be as follows:

    a. Clevis Type: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches & Smaller

        1) Products: Bare Steel Plastic or Insulated Pipe:

            a) Anvil Fig. 260
            b) Eaton Fig. 3100
            c) nVent Model 400

        2) Products: Bare Copper Pipe Felt or PVC Coated:

            a) Eaton Fig. B3104F or B3100CTC
            b) Anvil Fig. CT65
            c) nVent Fig. 402

    b. Adjustable Swivel Ring Type: Bare Metal Pipe - 4 inches and Smaller

        1) Products: Bare Steel Pipe:

            a) Anvil Fig. 69
            b) Eaton Fig. B3170NF
            c) nVent Model 115

        2) Products: Bare Copper Pipe:

            a) Eaton Fig. B3170CTC
            b) nVent 102A0 Series
            c) Anvil Fig. CT-69

7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

    a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

b. Strut used in damp areas, including the greenhouse bays, shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

a. Clamp Type: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller

1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
3) Products: Bare Steel, Plastic or Insulated Pipe:

a) Unistrut Fig. P1100 or P2500
b) Eaton Fig. B2000 or B2400
c) Anvil Fig. AS1200
d) nVent USC

4) Products: Bare Copper Pipe:

a) Eaton Fig. BVT
b) nVent CADDY Cushion Clamp

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):

1) Products:

a) Anvil Fig. 86
b) Eaton Fig. B3033/B3034
c) nVent Model 300 & 310

b. Steel Structure Clamps: Scissor Type Beam Clamps (for use with bar-joists and wide flange):

1) Products:

a) Anvil Fig. 228, 292
b) Eaton Fig. B3054
c) nVent Model 360

c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):

1) Products:

a) MCL. M1, M2 or M3

d. Concrete: Concrete Inserts, Single Rod Galvanized:

1) Products:

a) Anvil Fig. 282
b) Eaton Fig. B3014
c) nVent Model 355

e. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-23. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

f. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

g. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports for plumbing equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 22 05 50 for additional requirements for concrete bases in seismic applications.
2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 6 inches on all sides of the equipment (6 inches larger than factory base), except where pad extension would interfere with working space at equipment control panels and electrical panels.
3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
5. Equipment requiring bases is as follows:

a. Water heater

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Government. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.

E. Do not cut structural members without written approval of the Structural Engineer.

F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.5 ROOF PENETRATIONS

A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe penetrations. Refer to drawings for details.

B. Conical Pipe Boot: Seal pipes with surface temperature below 150F, penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color shall match roofing membrane.

C. Break insulation only at the clamp for pipes between 60F and 150F. Seal outdoor insulation edges watertight.

2.6 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Government's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. The Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

   a. The hanger is attached within 6" from a web/chord joint.
   b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact the Government.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel (Std. Weight or Heavier - Liquid Service):

   a. Maximum Spacing:

      1) 1-1/4" & under: 7'-0"
      2) 1-1/2": 9'-0"
      3) 2": 10'-0"
      4) 2-1/2": 11'-0"
      5) 3": 12'-0"
      6) 4" & larger: 12'-0"

2. Steel (Std. Weight or Heavier - Vapor Service):

   a. Maximum Spacing:

      1) 1-1/4" and under: 9'-0"
      2) 1-1/2": 12'-0"
      3) 2" & larger: 12'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

   a. Maximum Spacing:

      1) 3/4" and under: 5'-0"
      2) 1": 6'-0"
      3) 1-1/4": 7'-0"
      4) 1-1/2" 8'-0"
      5) 2": 8'-0"
      6) 2-1/2": 9'-0"
      7) 3": 10'-0"
      8) 4": 12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

   a. Maximum Spacing:

      1) 3/4" & under: 7'-0"
      2) 1": 8'-0"
      3) 1-1/4": 9'-0"
      4) 1-1/2": 10'-0"
      5) 2": 11'-0"
      6) 2-1/2" & larger: 12'-0"

5. Plastic Pipe:

   a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

I. Installation of hangers shall conform to MSS SP-58, -69, -89 and the applicable Plumbing Code.

END OF SECTION 22 05 29

SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 22.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM B-1, B-3, and B-8 for copper conductors.

C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 " 2kV Cables.

D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. 3M
2. Bunting
3. Calpico
4. Craftmark
5. Emedco
6. Kolbi Industries
7. Seton
8. W. H. Brady
9. Marking Services

2.2 MATERIALS

A. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

I. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.
3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.
2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the prior to ordering tags.
4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
5. Attach to handwheel or around valve stem.
6. Number all tags and show the service of the pipe.
7. Provide one Plexiglas framed valve directory listing all valves, with respective tag numbers, uses and locations. Mount directory in location chosen by the Government.
8. Provide one 36" x 24" minimum Plexiglas framed piping schematic showing valve locations with respective tag numbers. Mount directory in location chosen by the Government.
9. Provide two sets of laminated 8-1/2" x 11" (letter size) copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the and Government prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. Wire nuts shall not be used.
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:
1. DOMESTIC COLD WATER: White lettering; green background
2. DOMESTIC HOT WATER - White lettering; green background
3. DOMESTIC HOT WATER CIRCULATING: White lettering; green background
4. SANITARY SEWER: Black lettering; yellow background
5. VENT: Black lettering; yellow background
6. CARBON DIOXIDE - 50-55 PSI: White lettering; gray background
7. CARBON DIOXIDE UNDERGROUND PIPING - Tracer Wire - White lettering; green background

B. Non-Potable Piping: All piping conveying non-potable water shall be permanently identified by continuous painted or adhesive backed marker along entire length of pipe and branches so the piping is readily distinguishable from piping carrying potable water. Pipe markers shall be located as described above.

1. NON-POTABLE WATER: White lettering; purple background
2. DEIONIZED WATER: White lettering; purple background
3. RO WATER: White lettering; purple background

END OF SECTION 22 05 53

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

C. ANSI/ASTM C534 - Elastomeric Foam Insulation.

D. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.

E. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

F. ASTM E84 - Surface Burning Characteristics of Building Materials.

G. NFPA 255 - Surface Burning Characteristics of Building Materials.

H. UL 723 - Surface Burning Characteristics of Building Materials.

I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

1.4 SUBMITTALS

A. Submit shop drawings per Section 22 05 00. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534 Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

2.2 VAPOR BARRIER JACKETS

A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40F to 150F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

B. Insulated Piping Operating Below 60F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
3. All balance valves with fluid operating below 60F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60F and 140F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140F:

1. Insulate fittings, valves, flanges, and strainers.
2. All balance valves with fluid operating above 140F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping shall be insulated unless local code allows it to be uninsulated. In no instance should the uninsulated portion of the piping be more than 4ft in developed length.

3.3 SUPPORT PROTECTION

A. Insulation with pipe size greater than 1-1/2" shall be protected from sagging and crushing by one of the following means.

1. High Compressive Strength Insert: On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:

    a. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180-degree cylindrical segment the same length as metal shields. Inserts shall be:

b. Provide metal shields between hangers or supports and the pipe insulation/insert. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

1) Shields shall be at least the following lengths and gauges:

Pipe Size	Shield Size
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge
5" to 6"	18" long x 16 gauge
8" to 14"	24" long x 14 gauge
16" to 24"	24" long x 12 gauge

c. Where rolled steel plate is noted above, provide minimum 1/4" (6mm) rolled galvanized steel plates in addition to the shield as reinforcement on large pipes as noted above to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength.

2. Premanufactured Insulation Insert/Shield: As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.

a. Products:

1) Buckaroo CoolDry

2) Cooper/B-Line Fig. B3380 through B3384

3) Pipe Shields A1000, A2000

3. Premanufactured shield/saddle for use with Elastomeric Foam (Type B): Molded thermoplastic rigid pipe saddle sized for insulation outside diameter. Length as required by manufacturer.

B. Rectangular blocks, plugs, or wood material are not acceptable.

C. Temporary wood blocking may be used by the Contractor for proper height; however, these must be removed and replaced with proper inserts by the Contractor. Refer to Supports and Anchors specification section for additional information.

D. Neatly finish insulation at supports, protrusions, and interruptions.

3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Exterior installations shall contain factory applied polymeric, moisture, and UV resistant covering with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:

    a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
    b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

4. Insulation Installation on Valves and Pipe Specialties:

    a. Install preformed sections of same material as straight segments of pipe insulation when available.
    b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
    c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3.5 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.
5. Use plastic insulation covering on all exposed pipes including, but not limited to:

    a. All exposed piping in the greenhouse bays and greenhouse circulation corridor.
    b. All exposed piping within 8'-0" of the floor, including the pipe riser on each level going to the penthouse and within the penthouse.

c. All exposed piping that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

3.6 SCHEDULE

A. Refer to drawings for insulation schedule.

END OF SECTION 22 07 19

SECTION 22 09 00 - INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauges.

B. Thermometers.

1.2 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Specification for ASTM Thermometers.

1.3 SUBMITTALS

A. Submit shop drawings per Section 22 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with phenolic turret style, glycerin fillable, safety case with phosphor bronze or 316 stainless steel bourdon tube, brass socket for air, steam, water or oil applications. Gauges shall be 1/2% full scale accurate per ANSI B40.1 with bushed stainless steel movement and hair spring guard. Standard ranges to be either pressure or pressure and vacuum as required of application.

1. Manufacturer:

   a. Ashcroft
   b. Marshalltown
   c. Marsh
   d. Miljoco
   e. Trerice
   f. U.S. Gauge Figure 1980
   g. Weksler
   h. Wika.

B. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.

B. Shutoff Valve: 1/2" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/2" connections, porous metal type.

D. All pressure gauge piping shall be minimum 1/2" 304 stainless steel pipe or copper tube.

2.3 THERMOMETERS

A. Alcohol/Spirit Filled Type:

1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, and locking device to allow rotation of thermometer to any angle.
2. Select thermometer for appropriate temperature range.
3. Stem: Copper plated steel, aluminum, or brass for separable socket. Stem lengths as required for application with minimum insertion of 3-1/2".
4. Thermometers for water shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.
5. Manufacturer:

    a. Marsh
    b. Miljoco
    c. Trerice
    d. Weksler
    e. Wika.

B. Select scales to cover expected range of temperatures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.
2. Coil and conceal excess capillary on remote element instruments.
3. Install gauges and thermometers in locations where they are easily read from normal operating level.
4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.
2. Provide 1/2" tubing for pressure gauge and gauge accessories.
3. Provide snubber for each pressure gauge.
4. Provide coil syphon for each pressure gauge connected to steam piping.
5. Install gauges with bottom threaded connections at 6 o'clock position.

C. Thermometers:

1. Install piping system thermometers in sockets with short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION 22 09 00

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Valves.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 REFERENCES

A. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

B. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

C. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.

D. ANSI/ASTM B32 - Solder Metal.

E. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.

F. ANSI/AWS D1.1 - Structural Welding Code.

G. ASME - Boiler and Pressure Vessel Code.

H. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.

I. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.

J. ASTM B88 - Seamless Copper Water Tube.

K. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

L. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

M. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

N. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

O. ASTM D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

P. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.

Q. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

R. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

S. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

T. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

U. ASTM F2618 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.

V. AWS A5.8 - Brazed Filler Metal.

W. AWWA C651 - Disinfecting Water Mains.

X. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

Y. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.

Z. FM 1680 - Couplings Used in Hubless Cast Iron Systems.

AA. NSF - National Sanitation Foundation

1.4 SUBMITTALS

A. Submit shop drawings per Section 22 05 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 CAST IRON PIPE

A. Cast Iron; Standard Weight Epoxy Coated; No-Hub Sleeve Gaskets:

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, CISPI 301 and CISPI Trademark, epoxy paint corrosion protective coating inside and outside, EN-877.
2. Joints: ASTM C1540 and FM 1680.

   a. Super Duty, Shielded Stainless Steel Couplings: Neoprene sleeve gasket, 0.015" thick 304 stainless steel shield , stainless steel 3/8" screw type clamps, minimum of four clamps for 1-1/2" to 4" and six clamps for 5" and larger pipe sizes. Clamps shall be tightened to minimum 80 inch pounds or as manufacturer requires. Husky SD-4000 or equal.

3. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 301. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters specifically for the application. Adapter must meet the same requirements as the joints listed above. ASTM C1460. Sticker identifying transition fitting application must be visible to view.

2.2 COPPER PIPE

A. Copper Pipe; Type L; Solder Joints:

1. Pipe: Type L hard drawn seamless copper tube, ASTM B88.
2. Design Pressure: 175 psi; Maximum Design Temperature: 200F.
3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
4. Fittings: Wrought copper solder joint, ANSI B16.22.

B. Copper Pipe; Type K; Solder Joints:

1. Pipe: Type K annealed copper tube, ASTM B88.
2. Design Pressure: 150 psi. Maximum Design Temperature: 200F.
3. Joints: Solder with 100% lead-free solder and flux ASTM B32BCuP silver braze, AWS A5.8.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Corrosion Reducing Wrap: ASTM D-1248, Polyken #930, Northtown Polywrap-C, or equal alternative for copper pipe installed below grade.

2.3 PLASTIC PIPE

A. Chlorinated Polyvinyl Chloride (CPVC); Schedule 40 Drainage; Solvent Weld Joints:

1. Pipe: Chlorinated polyvinyl chloride (CPVC) Schedule 40 drainage pipe, ASTM F2618, NSF Listed.
2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer, ASTM F493.
3. Fittings: Chlorinated polyvinyl chloride (CPVC) DWV pattern with socket ends for Schedule 40 pipe.

4. Limitations: CPVC shall not be used in a return air plenum unless it is specifically listed to ASTM E84 and/or UL723. CAN ULC S102.2 listing is not acceptable.
5. Special Requirements: Provide expansion loop(s) and/or expansion joints in the piping system per the manufacturer's guidelines and as shown on the drawings. Refer to Section 22 05 16 for expansion joint requirements.

2.4 VALVES

A. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
2. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, threaded or solder ends (acceptable only if rated for soldering in line with 470F melting point of lead-free solder), stainless steel ball and trim, Teflon seats and seals.

1) Body: Lead free NSF-372, two-piece bronze of a copper alloy containing less than 15% zinc. Apollo Valves; a division of Aalberts–IPS #77CLF140/240 Series, Milwaukee #UPBA450S, Watts #LFB6080G2-SS, NIBCO #T-585-66-LF, Jomar T-200CSSG.
2) Body: Dezincification resistant brass alloy, lead free NSF-372. Jomar T-100CSSG.
3) Provide solid extended shaft for all insulated piping. (For example, Apollo adds option -04 Stem Extension, NIBCO Nib-Seal Handle-NS, and Jomar modifies valve part number with -IH for insulated handle.)
4) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120F and as indicated on the drawings. Solid extended shaft is not required on valves with lockout trim. (For example, Jomar and NIBCO modify valve part number with -LH for locking handle.)

2.5 CHECK VALVES

A. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

B. CK-1: Threaded Ends, 2" and under, 125 psi steam at 406F, 200 psi CWP at 150F, threaded connection, lead free bronze body with brass or bronze disc, horizontal swing. Hammond #UP904, Milwaukee #UP509, NIBCO T-413-Y-LF, Jomar T-511G, Apollo Valves, a division of Aalberts-IPS #161T-LF.

2.6 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120F and as indicated on the drawings.

2.7 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

2.8 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron and steel connected to each other.
2. Brass, copper, and bronze connected to each other.
3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed and/or Grooved Joints (acceptable up to 4" size):

1. Dielectric waterway rated for 300 psi CWP and 225F.
2. Optional: Copper-silicon casting conforming to UNS C87850 with grooved and/or threaded ends.
3. UL classified in accordance with ANSI / NSF-61 for potable water service.
4. Manufacturers:

   a. Elster Group ClearFlow fittings
   b. Victaulic Series 647
   c. Grinnell Series 407
   d. Matco-Norca

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
6. Manufacturers:

   a. EPCO
   b. Central Plastics
   c. Pipeline Seal and Insulator
   d. F. H. Maloney
   e. Calpico

PART 3 - EXECUTION

3.1 PREPARATION

A. Install all products per manufacturer's recommendations.

B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

E. Connect to equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.

G. Roof Penetration (Vent) Flashing:

1. Membrane, Metal or Shingled Roofs: Flash vents with premolded pipe flashing cones for single-ply membrane roofs, metal roofs, or shingled roofs.

H. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 SYSTEM, PIPING AND VALVE SCHEDULE

A. Cold Water, Hot Water, Tempered Water - Potable and Non-Potable (Above Ground):

1. Copper Pipe; Type L; Solder Joints: All Sizes
2. Shutoff Valves: BA-1
3. Check Valves: CK-1

B. Carbon Dioxide - CO2 (Underground):

1. Copper Pipe; Type K; Brazed Joints (solder joints are not permitted): All Sizes
2. **Special requirements: All underground piping shall be installed within continuous and watertight 4" Sch. 40 PVC sleeve for protection from damage and corrosion. PVC sleeve shall extend at least 6" above grade and shall have watertight removable cap and seal.**

3. Carbon Dioxide - CO2 (Aboveground):Copper Pipe; Type L; Brazed Joints (solder joints are not permitted): All Sizes
4. Shutoff Valves: BA-1

C. Sanitary Waste and Vent and Indirect Drainage, Gravity (Above Ground):
   1. Cast Iron; Standard Weight Epoxy Coated: No-Hub Sleeve Gaskets: 1-1/2" to 15". **Use for ALL plumbing within existing building.** Rigid Chlorinated Polyvinyl Chloride (CPVC) ;Schedule 40; Solvent Weld Joints; (65 mm) (200 mm) DWV fittings: 1-1/4" to 4". **Use CPVC for all plumbing within new building because of the use of bleach to disinfect waste water.**

D. Sanitary Waste and Vent, Gravity (Underground - Inside Building):

   1. Cast Iron; Standard Weight Epoxy Coated; No-Hub Sleeve Gaskets: 1-1/2" to 15". **Use for ALL plumbing within existing building. Drains must be suitable for high temperature water discharge.**
   2. Rigid Chlorinated Polyvinyl Chloride (CPVC) ;Schedule 40; Solvent Weld Joints; (65 mm) (200 mm) DWV fittings: 1-1/4" to 4". **Use CPVC for all plumbing within new building because of the use of bleach to disinfect waste water.**

3.3 TESTING PIPING

A. Sanitary Drainage, Sanitary Vent:

   1. Test all piping with water to prove tight.
   2. Test piping before insulation is applied.
   3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
   4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
   5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
   6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
   7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. Hot Water - Potable and Non-Potable, Cold Water - Potable and Non-Potable, Tempered Water - Potable and Non-Potable:

   1. Test pipes underground or in chases and walls before piping is concealed.
   2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
   3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen. Exception: Inert gas test shall not be used to test plastic piping.
   4. Hold test pressure for at least 2 hours.
   5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. All Other Piping:

   1. Test piping at 150% of normal operating pressure.
   2. Piping shall hold this pressure for one hour with no drop in pressure.
   3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
   4. Drain and clean all piping after testing is complete.

3.4 CLEANING PIPING

A. Air Blow:

1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.
2. Air blow applies to the following systems:
   a. Carbon Dioxide (CO_2)

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

3.5 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.
2. Provide clearance for installation of insulation and access to valves and fittings.
3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.

D. Sanitary Piping:

1. Install all sanitary piping inside the building with a slope as shown on the drawings.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Slope sanitary piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 2 feet per second.
4. All sanitary and storm piping shall have at least 42" of cover when leaving the building.

3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.

D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.

G. Provide flanges or unions at all final connections to equipment, traps and valves.

H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

I. Use full and double lengths of pipe wherever possible.

J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.

K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.

M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45-degree or 90-degree angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

3.7 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal water lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.

B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.

C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

D. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.

E. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

F. All vent and drain piping shall be of same materials and construction for the service involved.

3.8 PLUMBING VENTS

A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.

B. Extend the high side of the soil and waste stacks at least 12" above roof.

C. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.

D. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.

E. In no case shall the vent through the roof be less than 4" in diameter.

F. Vent pipes through the roof shall be located a minimum of 10 feet from any air intake opening on the roof.

3.9 BRANCH CONNECTIONS

A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:

1. Domestic water piping above ground.

E. Further limit use of mechanically formed fittings as follows:

1. Must have at least same pressure rating as the main.
2. Main must be Type K or L copper tubing.
3. Permanent marking shall indicate insertion depth and orientation.
4. Branch pipe shall conform to the inner curve of the piping main.
5. Main must be 1" or larger.
6. Branch must be 3/4" or larger.

F. Forged weld-on fittings are limited as follows:

1. Must have at least same pressure rating as the main.
2. Main must be 2-1/2" or larger.
3. Branch line is at least two pipe sizes under main size.

3.10 JOINING OF PIPE

A. Solder Joints (Copper Pipe):

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470F melting point solder. Remove discs and seals during soldering if they are not suitable for 470F.

B. Brazed Joints (Copper Pipe):

1. Make up joints with silver alloy brazing filler metal conforming to ASTM B260 "Brazing Filler Metal" BAg-1 or BAg-2. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply non-corrosive flux of the type recommended by filler alloy manufacturer, evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly using oxygen-acetylene torch with tip size recommended by fitting manufacturer. Wipe and brush joint clean after alloy has set.
2. Remove discs from solder end valves during brazing.

C. Hub and Spigot Joints - Sanitary Pipe (Cast Iron Pipe):

1. Compression Gasket Joints: Joint shall be one-piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.

D. Solvent Weld Joints (CPVC):

1. Make joints with a one-step process. Use CPVC cement conforming to ASTM F493. A primer is not required.
2. If a primer is required by the Authority Having Jurisdiction, then a primer conforming to ASTM F656 shall be used.
3. All contractor personnel that will prepare solvent cemented joints shall be qualified for such bonding practices according to the bonding qualifications procedures described in ASME B31.3, Chapter VII for bonding of plastic piping.

E. No-Hub Sleeve Gaskets (No-Hub) (Cast Iron Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.
2. The gasket shall have an internal center stop.
3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

F. Couplings: Assemblies with combinations of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

G. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

H. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

3.11 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfection of the domestic water piping shall be completed within three (3) weeks prior to building occupancy. Contractor is responsible for disinfecting water piping if used by workers during construction; disinfection during construction does not eliminate the requirement for final disinfection prior to occupancy. Flushing of piping shall be completed within two (2) weeks prior to building occupancy.

B. Provide necessary connections at the start of individual sections of mains for adding chlorine.

C. Before starting work, verify system is complete, flushed and clean.

D. Follow the disinfection of potable water procedure outlined in this project's applicable plumbing code. For example: IPC 610.1, UPC 609.10, CPC 609.10, and Illinois 890.1180. Where local codes do not outline a disinfection procedure, follow the International Plumbing Code procedure 610.1.

E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.

F. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

3.12 SERVICE CONNECTIONS

A. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION 22 10 00

SECTION 22 10 30 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleanouts.

B. Traps.

C. Floor Drains and Sinks

D. Hub Drains and Standpipes

E. Backflow Preventers.

F. Strainers.

G. Unions.

H. Balancing Valves.

I. Water Hammer Arresters.

J. Dielectric Fittings (Connections Between Dissimilar Metals).

K. Drain Valves.

1.2 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

B. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 REFERENCES

A. ANSI A112.21.1 - Floor Drains.

B. ASSE 1010 - Water Hammer Arresters.

C. ANSI A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.

D. ANSI 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering.

E. ANSI 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering.

F. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 1.

G. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering.

H. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

I. PDI WH-201 - Water Hammer Arresters.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Provide cleanouts as shown and specified on the drawings as well as required by code.

B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.

C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.

D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 YARD CLEANOUTS

A. Provide yard cleanouts as shown and specified on the drawings as well as required by code.

B. Cleanout shall be same size as pipe up to 6" and 6" for larger pipes.

2.3 TRAPS

A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be of the same material as specified for waste system.

B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.

C. Deep seal pattern traps shall be provided where required by code.

D. Each trap shall be completely filled with water at the end of construction but before building turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water.

2.4 FLOOR DRAINS AND SINKS

A. Floor drains and sinks shall be in the form of a receptor with grate/strainer set flush with the surrounding floor.

B. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.5 HUB DRAINS AND STANDPIPES

A. A hub drain shall be in the form of a hub or pipe without a grate/strainer extending through the floor for receiving indirect waste. A hub drain has a flood level rim above the finished floor.

B. Provide hub drains as shown and specified on the drawings as well as required by code.

2.6 BACKFLOW PREVENTERS

A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

2.7 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

1. Water:

a. 1/4" - 2": 3/64" perforations

B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.8 UNIONS

A. Copper pipe - wrought copper fitting - ground joint.

2.9 BALANCING VALVE

A. Rated for 125 psi working pressure and 250F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design "Accusetter", Preso "B+", Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold "Quickset", Gerand "Balvalve Venturi" or Nibco Globe Style balancing valve.

D. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.

E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.10 WATER HAMMER ARRESTERS

A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100F and 300F and maximum 250 psig working pressure.

2.11 DIELECTRIC FITTINGS (CONNECTIONS BETWEEN DISSIMILAR METALS)

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.
2. Brass, copper, and bronze connected to each other.
3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225F.
2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.12 DRAIN VALVES

A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Coordinate construction to receive drains at required invert elevations.

B. Install all items per manufacturer's instructions.

C. Water Hammer Arresters:

1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with the Government.
2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.
3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.
2. Provide a cleanout at the upstream end of a horizontal waste pipe in a plumbing chase serving multiple plumbing fixtures; for example a bank of water closets or lavatories.
3. Provide cleanouts on the branch line connected to individual plumbing fixtures as required by code; for example just below a sink, lavatory or urinal.
4. Extend underfloor cleanouts up to the floor with long sweep elbows.
5. Install a full size, two-way cleanout within 5 feet of the foundation inside of building.

6. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.
7. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.

E. Yard Cleanouts:

1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.
2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.

F. Floor Drains and Floor Sinks:

1. Coordinate sloping requirements with the architectural plans and specifications.
2. Top of floor drain and sink grate/strainer shall not extend above the finished floor elevation. Grate/strainer shall be installed flush with surrounding finished floor. Should the Contractor believe this presents a conflict with code, the issue should be evaluated before installation of the floor drain or sink begins. Proceeding with installing a floor drain or sink raised above the finished floor without prior approval will result in the Contractor being required to remove the drain or sink in question and reinstall it at the approved elevation.

G. Hub Drains and Standpipes:

1. The top of a hub drain/standpipe shall extend above the finished floor elevation. Refer to drawings for dimensions above the finished floor.
2. Access shall be provided to drains and standpipes for rodding.

H. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.
2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.
3. Install unit between 12" and 60" above finish floor in a location that is accessible for annual testing and maintenance.

I. Balancing Valves:

1. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.

END OF SECTION 22 10 30

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic Water In-Line Circulators.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.

PART 2 - PRODUCTS

2.1 GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Domestic hot water pumps shall be suitable for 225F water.

F. Motors shall comply with Section 22 05 13.

G. Submitted pump selections must have a diameter impeller that meets or exceeds the scheduled pump. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 DOMESTIC WATER IN-LINE CIRCULATORS

A. Provide pumps as specified on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.
2. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

B. In-Line Pump:

1. Support in-line pumps individually so there is no strain on the piping. Support pump so no weight is carried on pump casings. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
2. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
3. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Government, manufacturer shall provide a factory trained representative to field align the shafts.
4. Alignment shall be inspected and approved by a factory trained representative. If alignment is not satisfactory, representative shall field align this shaft.

END OF SECTION 22 11 23

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All plumbing fixtures.

1.2 REFERENCES

A. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

B. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.

C. Americans with Disabilities Act (ADA), Title III.

D. The Energy Policy Act (EPAct) of 2005.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. The Government does not review or approve carriers except for manufacturer.

B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.

PART 2 - PRODUCTS

2.1 DSA FIXTURE REQUIREMENT

A. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.

B. Fixture controls shall comply with CBC Sections 11B-601.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.9.5 for children's water closets, 11B-605.4 for urinals, 11B-606.4 for lavatories and sinks, 11B-607.5 for bathtubs, 11B-608.5 for showers, and 11B-611.3 for washing machines and clothes dryers.

C. Accessible sinks shall be 6-1/2" deep maximum. Sinks shall be mounted with the front of the higher of the rim and counter surface 34" maximum above the finish floor or ground.

D. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. CBC Section 11B-606.

2.2 MATERIALS

A. All fixtures shall be as shown on the drawings and as scheduled in the plumbing material list. Additional requirements below:

B. All lavatory and sink trim shall be from the same manufacturer where possible.

C. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

D. P-Traps and Tailpieces:

1. Sinks:

a. 1-1/2" CPVC tailpiece and p-trap with cleanout on bottom of trap. All drain materials shall be compatible with bleach.

2. Acceptable Manufacturers:

a. McGuire
b. Keeney
c. Dearborn Brass
d. Zurn
e. Chicago Faucet

E. Insulation Covers for Accessible Sinks:

1. Premanufactured cover for P-trap, stop valves, and supply lines.

a. 1/8" thick vinyl construction, paintable, tool free installation,
b. Acceptable Manufacturers:

1) Truebro (Lav Guard 2)
2) Plumberex (Pro-Extreme)
3) McGuire (Prowrap)
4) Buckaroos Inc.
5) Zurn

F. Angle Stops and Supplies:

1. Sinks:

a. Lead-free, 3/8" chrome plated brass, quarter turn ball valve type, solder or compression connection type.
b. Lead-free, 3/8" chrome plated soft copper risers **or** stainless steel braided reinforced PVC hose.
c. Acceptable Manufacturers:

1) McGuire
2) BrassCraft
3) Keeney

4) Zurn
5) Chicago Faucet

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
3. Provide fixtures with supply lines, stop valves, reducers, escutcheons, and any other items required for a complete and operational plumbing fixture assembly.
4. Install components level and plumb.
5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
7. Refer to **P**lumbing Material List and architectural drawings for fixture mounting heights. In the event of a conflict between the two, contact the A/E for clarification before beginning work.
8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

B. ADA Accessible Exposed Sink Trim:

1. All exposed sink traps, piping and angle stops installed at accessible sink locations shall include offset style drain tailpiece, p-trap installed near and parallel with back wall, and insulation kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

3.2 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION 22 40 00

SECTION 22 67 00 - PLUMBING PURE WATER PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Deionized Water Pipe and Fittings

B. Reverse Osmosis Pipe and Fittings

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Code.

B. ASTM D1193 - Standard Specification For Reagent Water

C. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.

D. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00. Include manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 TYPE I WATER

A. Research Lab Standards:

1. Electrical Resistivity: 18 mega-ohm at 77F
2. Total Organic Carbon: Less than 10 PPB

B. ASTM Standards:

1. Electrical Resistivity: 18 mega-ohm at 77F
2. Total Organic Carbon: 50 PPB

2.2 TYPE I ULTRA-PURE WATER - PIPING

A. Design Pressure: 150 psi at 70F

B. Piping:

1. Pipe: SDR11 polypropylene natural (without plasticizers or pigments), NSF 61 and 372, USP Class VI. System max pressure rating of 150 psi.
2. Joints: Bead and Crevice Free.
3. Fittings: Bead and Crevice free fittings.
4. Products: All manufacturers must have approval to furnish this system. Purity test data and fitting samples are required for evaluation of equivalency.
5. Limitations: Not for use in return air plenums or where exposed to UV light. Do not use with ozone or hot water sanitization processes.
6. Acceptable products are as follows: Georg Fischer (GF) PROGEF Natural PP, or similar approved product from Enfield, Nibco/Chemtrol, Orion Pure Water Piping.

    a. Quality Assurance: All pipe and fittings shall have their ends bagged and sealed or plugged from the time of manufacture until just prior to joining. Open-end pipe is not permitted on the job site. This applies both before and after installation. If, in the Owner's opinion, insufficient care has been taken to keep the pipe interior clean, the Contractor shall perform the cleaning procedure twice at Contractor's cost, draining between sterilizations.

C. Piping

1. Pipe: PN10 polyvinylidene fluoride PVDF from virgin, unpigmented resin, USP Class VI. System max pressure rating of 150 psi.
2. Joints: Bead and Crevice Free type.
3. Fittings: Polyvinylidene fluoride PVDF, Bead and Crevice Free.
4. Limitations: Allowable for use in return air plenums.
5. Acceptable products are as follows: Georg Fischer (GF) SYGEF Standard, or similar approved product from IPEX Plenumline, Nibco/Chemtrol, Simtech, Orion.

    a. Quality Assurance: All pipe and fittings shall have their ends bagged and sealed or plugged from the time of manufacture until just prior to joining. Open-end pipe is not permitted on the job site. This applies both before and after installation. If, in the Owner's opinion, insufficient

care has been taken to keep the pipe interior clean, the Contractor shall perform the cleaning procedure twice at Contractor's cost, draining between sterilizations.

D. Valves:

1. Unless noted otherwise, valves shall be diaphragm valves.
2. All valves shall be purchased as a complete system by piping manufacturer.

E. Faucets:

1. All faucets shall be purchased as a complete system by piping manufacturer.
2. All faucets for Type I shall be recirculating, flow through type with inline flow diverter.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install all products per manufacturer's recommendations.

B. Ream pipe and tube ends. Remove burrs.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Connect to equipment with flanges or unions.

3.2 TESTING PIPING

A. Test piping at 150% of normal operating pressure.

B. Piping shall hold this pressure for one hour with no drop in pressure.

C. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.

D. Drain and clean all piping after testing is complete.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative.
2. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.

3. Prior to flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. Cleaning Piping:

1. Clean as required by Pure Water Equipment Vendor to maintain required water quality.

3.4 INSTALLATION

A. General Installation Requirements:

1. Install all items in accordance with manufacturer's instructions.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment. Do not clamp piping rigidly to structure.
5. Slope water piping and arrange to drain at low points.
6. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
7. All outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Pure Water, Not for Human Consumption." Sign shall have black lettering on a yellow background.
8. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Provide clearance for installation of insulation and access to valves and fittings.
2. Provide access doors for concealed valves and fittings.
3. Install valve stems upright or horizontal, not inverted.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.

D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows.

G. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

H. Use full and double lengths of pipe wherever possible.

I. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

J. Unless otherwise indicated on the drawings, all horizontal water piping shall pitch 1" in 40 feet to low points for complete drainage back to tank.

K. Maintain accurate grade where pipes pitch or slope for drainage. No pipes shall have pockets due to changes in elevation. Entire system must be completely drainable.

L. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage.

3.6 BRANCH CONNECTIONS

A. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

3.7 PURE AND ULTRA-PURE WATER SYSTEM INSTALLATION

A. Provide incoming water connections and distribution loop connections. Set equipment in place and provide interconnecting piping and wiring for system.

B. Provide starters and disconnects for a complete and functioning system.

C. Arrange for the system manufacturer to provide supervision for system installation.

3.8 JOINING OF PIPE

A. Fusion Weld (socket, infrared, butt, bead and crevice free):

1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.
2. Make sure proper heating heads are used for male and female situations.
3. Bevel the leading edge of pipe section with a 45-degree chamfer.

4. Utilize a fusion welding or BCF (as specified in Part 2) tool recommended and/or provided by the pipe and fitting manufacturer.
5. Not recommended for temperatures below 40F.
6. Follow the manufacturer's cold weather installation procedures.
7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
8. Follow all manufacturer's installation instructions.

END OF SECTION 22 67 00

SECTION 23 05 00 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.

C. Scope of Work:

1. Mechanical Work shall include, but is not necessarily limited to:

   a. Furnish and install steam-to-water heat exchanger with connection to steam system.
   b. Furnish and install complete heating water system including pumps, piping, insulation, air control equipment, terminal heating equipment, and specialties. Make final connections to all coils, including those furnished by others.
   c. Furnish and install concrete housekeeping pads for all floor mounted mechanical equipment.
   d. Extend existing steam distribution system including piping, insulation, terminal heating equipment, traps, and specialties. Make final connections to all coils, including those furnished by others.
   e. Furnish and install humidifiers, piping, and accessories.
   f. Furnish and install condensate drain piping from cooling related equipment such as RTUs and cooling coil drain pans.
   g. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
   h. Furnish and install package rooftop air handling units complete with curbs.
   i. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
   j. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
   k. Furnish and install ventilation air fan, louvers, and dampers.
   l. Furnish and install complete autoclave hood exhaust system including fans, ductwork, and fittings.
   m. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
   n. Furnish and install mechanical room ventilation systems including louvers, ductwork, insulation, and fans.

o. Furnish and install a complete temperature control system as specified in Section 23 09 00.
p. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.
q. Furnish automatic control valves and dampers.
r. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
s. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
t. Complete all applicable tests, certifications, forms, and matrices.

1.3 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Government, shall be scheduled with the Government. It may be necessary to schedule such work during unoccupied hours. The Government reserves the right to determine when restricted construction hours will be required.

B. Itemize all work and list associated hours and pay scale for each item.

1.4 ELECTRICAL WORK

A. Definitions:

1. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
2. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
3. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
4. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

    a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

5. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

6. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The Contractor is responsible for all electrical work required for items such as temperature controls, mechanical equipment, fans, and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Contractor.
2. The Contractor shall provide complete electrical power/controls wiring diagrams and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring for mechanical equipment and devices unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. The Contractor shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

    a. Light fixtures.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical busduct.
    d. Sheet metal.
    e. Electrical cable trays, including access space.
    f. Electrical conduits and wireway.

C. Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment, for example:
    a. Condensate Return Stations.
    b. Electric Humidifiers.
    c. Packaged Rooftop Units.

2. Assumes all responsibility for temperature control wiring. All control wiring shall be installed in conduit.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Government of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

4. Contractor's Responsibility:

    a. Wiring of all devices needed to make the Temperature Control System functional.
    b. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Contractor.
    c. Coordinating equipment locations (such as relays, transformers, etc.).

5. This Contractor is responsible for coordination of utilities. If any field coordination conflicts are found, the Contractor shall be responsible for determining a viable layout.
6. Provides all combination starters, manual starters and disconnect devices.
7. Installs and wires all remote control devices.
8. Provides motor control and temperature control wiring.
9. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
    b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
    c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
    d. Maintenance clearances and code-required dedicated space shall be included.
    e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify the Government of the maximum clearance which can be maintained. Failure to comply will result in modifications at the Contractor's expense.

    a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.

3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The Contractor shall participate in the coordination drawing process.
2. The Contractor shall prepare a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.

3. The Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

4. Government Representative will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver. Blatant reproductions of original file copies is not an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Government Representative.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1'-0" (minimum).
      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Government Representative for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Government Representative. The Government Representative will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. The Contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The Contractor will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The Contractor will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Government Representative reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Government Representative.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the Government Representative at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Government's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Government.

10. Complete the coordination drawing and approval process prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the Contractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Government prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. The Contractor shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Peoria, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of the USDA.
3. Conform to all State Codes.
4. If there is a discrepancy between the codes and regulations and these specifications, the Government Representative shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Government in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Government.
7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Government or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Government.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.
    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings. Refer to Division 1 for submittal requirements and procedures.

1. Submittals List:

Referenced Specification Section	Submittal Item
23 05 29	Hangers and Supports
23 05 29	Prefabricated Curbs

Referenced Specification Section	Submittal Item
23 05 48	Vibration Isolation Equipment
23 05 50	Seismic Restraint Systems
23 05 53	HVAC Identification
23 05 93	Testing, Adjusting, and Balancing
23 07 13	Duct Insulation
23 07 16	HVAC Equipment Insulation
23 07 19	HVAC Pipe Insulation
23 09 00	Controls
23 09 13	Instrumentation
23 21 00	Hydronic Piping Systems and Valves
23 21 23	HVAC Pumps
23 22 00	Steam and Condensate Piping Systems and Valves
23 22 18	Traps and Condensate Return Equipment
23 22 18	Humidifiers
23 25 00	Chemical Treatment Systems
23 31 00	Ductwork
23 31 00	Ductwork Layout Drawings
23 34 13.13	Mixed Flow Laboratory Exhaust Fans
23 34 16	Centrifugal Fans
23 34 23	Power Ventilators
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 40 00	Filters and Filter Systems
23 57 00	Heat Exchangers
23 74 16.12	Packaged Rooftop Air Conditioning Units
23 82 00	Terminal Heat Transfer Equipment

1.8 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
   1. Base Mounted Pumps
   2. Packaged Rooftop Units
   3. Humidifiers
   4. Steam condensate pump station

B. Contractor shall arrange for and obtain supplier's on-site inspections at proper times to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

1. Motor windings and ventilation openings.
2. Bearings.
3. Equipment Pipe and Accessories connections openings. (e.g. boiler connections, coil connections, etc.)
4. Equipment Duct and Accessories connections openings. (e.g. RTU duct connections, air inlets and outlets, etc.)
5. Starter and control cabinets.
6. Heat transfer coils.
7. Pump Seals.

C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Government that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.

D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Government. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, they shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Government.

1.11 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Government for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Government.

C. Warranty requirements shall extend to correction, without cost to the Government, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.12 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.13 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.

B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Covering exterior walls, interior partitions and chases.
2. Installing hard or suspended ceilings and soffits.

B. The Government Representative will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Government Representative's review. This includes, but is not limited to:

a. Pipe insulation is installed and fully sealed.
b. Pipe and duct wall penetrations are sealed.
c. Pipe identification and valve tags are installed.
d. Main, branch and flexible ducts are installed.
e. Diffusers, registers and grilles are installed and connected to ductwork.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Government Representative finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Government Representative may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 01.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Government so that the final observation can be scheduled.
4. It is understood that if the Government Representative finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Government's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including PDF drawings and specifications.
3. A report documenting the instructions given to the Government's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Government Representative.
4. Inspection by State Boiler Inspector.
5. Start-up reports on all equipment requiring a factory installation inspection or start-up.
6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by the Government Representative required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Government's review and approval. The electronic copy shall be corrected as required to address the Government's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Government.
2. Approved O&M manuals shall be completed and in the Government's possession prior to Government's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Government.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. O&M file name: O&M.div23.contractor.YYYYMMDD
    b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Government with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Government, three paper copies of the O&M manual shall be provided to the Government. The content of the paper copies shall be identical to the corrected electronic copy.
2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Government's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.

8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.
10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE GOVERNMENT'S REPRESENTATIVES

A. Adequately instruct the Government's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Government's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a video recording of instructions to the Government Representatives while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Government Representative.

D. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Explanation of all air handling systems.
3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
4. Maintenance of equipment.
5. Greenhouse Purge systems.
6. Start-up procedures for all major equipment.
7. Explanation of seasonal system changes.
8. Description of emergency system operation.

E. Notify the Government of the time and place for the verbal instructions to be given to the Government's representative so a representative can attend if desired.

F. Minimum hours of instruction for each item shall be:

1. Heating Water & Steam/Condensate Systems - 2 hours.
2. Humidification System - 2 hours.
3. Chemical Treatment System - As defined in Section 23 25 00.
4. Air Handling & Exhaust Systems - 4 hours.
5. Temperature Controls - As defined in Section 23 09 00.

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Government prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Government's Representatives for the mechanical and control systems.
2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Government to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

F. The Contractor and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Government is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Government on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Government for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

A. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.

D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

E. Record changes daily and keep the marked drawings available for the Government Representative's examination at any normal work time.

F. Upon completing the job, and before final payment is made, give electronic PDF record drawings to the Architect/Engineer.

3.8 PAINTING

A. Paint all equipment that is marred or damaged prior to the Government Representative's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.

C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Government the color preference and furnish this color.

E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

F. Paint all outdoor uninsulated steel piping the color selected by Government Representative.

G. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Government's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Government's designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Government Representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.11 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

   a. Minimizing the amount of dust generated.
   b. Reducing solvent fumes and VOC emissions.
   c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
   d. Protect stored on-site and installed absorptive materials from moisture damage.

2. Request that the Government designate an IAQ representative.

3. Review and receive approval from the Government's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
5. Schedule activities that may cause IAQ conditions that are not acceptable to the Government's IAQ representative during unoccupied periods.
6. Request copies of and follow all of the Government's IAQ and infection control policies.
7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".
10. If permanently installed air handlers are used to serve both construction and occupied areas, all return grilles throughout construction areas shall be sealed to prevent air from construction areas being supplied to occupied areas.
11. If permanently installed air handlers are used during construction to serve only construction areas and do not supply air to adjacent occupied areas, MERV 8 filtration media shall be used to protect each return air grille or opening. The intent of this will be to prevent construction dust and debris from entering any return or supply air ductwork in the facility. All filtration media shall be replaced immediately prior to occupancy.
12. Construction areas shall be maintained at a negative pressure at all times during construction. When areas are under construction, HEPA filtered exhaust fan(s) shall be installed in sufficient quantities as required to maintain construction areas at sufficient negative pressure as called for in the Government's Infection Control Risk Assessment (ICRA). HEPA filtered exhaust fan discharge shall be ducted either outdoors or back into designated hospital areas as called for in the Government's ICRA.

3.12 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.

B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.

C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.

D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.

E. The following steps shall be taken during testing, adjusting, and balancing of each air system:

1. All construction activities in all spaces served by the air system shall stop.
2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.
4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.

F. The Government shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

3.13 UTILITY REBATE

A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, water heaters, programmable thermostats, and motors.

B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
4. All pumps, boilers and chillers operating and balanced.
5. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
6. All temperature control systems operating, programmed and calibrated.
7. Pipe insulation complete, pipes labeled and valves tagged.
8. Fire damper and fire/smoke damper access doors labeled in accordance with specifications.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION 23 05 00

SECTION 23 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 - Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. The Building Officials and Code Administrators National Building Code

J. 1997 Uniform Building Code

K. 2021 International Building Code

L. NFPA 5000 - Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 CFM/sq. ft at both ambient temperature and 400F for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Contractor associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Government.

1. Review foreseeable methods related to firestopping work.
2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Dow Corning Corp.
10. Fire Trak Corp.
11. International Protective Coating Corp.
12. HoldRite

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:

   a. F Rating = Floor/Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999

Penetrating Item	UL System No.
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall/Floor Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Government, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Government and manufacturer's factory representative. The Government shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any

firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Government's discretion and the Contractor's expense.

END OF SECTION 23 05 03

SECTION 23 05 29 - HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.

B. Equipment Bases and Supports.

C. Sleeves and Seals.

D. Flashing and Sealing of Equipment and Pipe Stacks.

E. Cutting of Openings.

F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.

B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

C. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

D. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:
   1. Steel Pipe:
      a. Hanger Rod Diameter:
         1) 2" and smaller: 3/8"
         2) 2-1/2" through 3-5/8": 1/2"
         3) 4" through 6": 1/2"
         4) 8": 5/8"
   2. Copper Pipe:
      a. Hanger Rod Diameter:
         1) 2" and smaller: 3/8"
         2) 2-1/2" through 3-5/8": 1/2"
         3) 4") through 6": 1/2"

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:
   1. Greenhouse Bays.

2.2 PIPE AND STRUCTURAL SUPPORTS

A. General:
   1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, -69, -89, and -127 (where applicable).
   2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

B. Vertical Supports:
   1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 10 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

a. Products:

1) Eaton Fig B3373 Series
2) nVent 510 Series
3) Anvil Fig. 90

2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

a. Products:

1) Mason RBA, RCA or RDA
2) Mason BR

3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.

a. Products:

1) Pipeshields, Inc E1000, E1100, E1200, or E1300 (manufacturer to confirm based on pipe diameter and weight when in service)

4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65°F to +225°F.
3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
4. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

a. Products:

1) Anvil Fig. 160, 161, 162, 163, 164, 165
2) Eaton Fig. 3160, 3161, 3162, 3163, 3164, 3165
3) nVent Model 630, 631, 632, 633, 634, 635

5. Unless otherwise indicated, hangers shall be as follows:

    a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and Smaller:

        1) Products: Bare Steel, Plastic or Insulated Pipe:

            a) Anvil Fig. 260
            b) Eaton Fig. 3100
            c) Roller Type: Service: Insulated Hot Pipe - 4 inches and Larger:

        2) Products: 4" through 6":

            a) Anvil Fig. 181, 271
            b) Eaton Fig. 3110
            c) nVent Model 610

        3) Products: 8" and Above:

            a) Anvil Fig. 171, 271
            b) Eaton Fig. 3114, 3117
            c) nVent Model 605

    b. Adjustable Swivel Ring Type: Service: Bare Metal Pipe - 4 inches and Smaller:

        1) Products: Bare Steel Pipe:

            a) Anvil Fig. 69
            b) Eaton Fig. B3170NF
            c) nVent Model 115

        2) Products: Bare Copper Pipe:

            a) Eaton Fig. B3170CTC
            b) nVent 102A0 Series
            c) Anvil Fig. CT-69

6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

    a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
    b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

    a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller:

        1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
        2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
        3) Products: Bare Steel, Plastic or Insulated Pipe:

            a) Unistrut Fig. P1100 or P2500
            b) Eaton Fig. B2000 or B2400
            c) Anvil Fig. AS1200
            d) nVent USC

        4) Products: Bare Copper Pipe:

            a) Eaton Fig. BVT
            b) nVent CADDY Cushion Clamp

    b. Roller Type: Service: Insulated Hot Pipe - 4 inches and larger:

        1) Products: 4" through 6":

            a) Unistrut Fig. P2474
            b) Eaton Fig. B218
            c) Anvil Fig. ROL-12
            d) nVent ROL12

        2) Products: 8" and Above:

            a) Unistrut Fig. P2474-1
            b) Eaton Fig. B219
            c) nVent Fig. ROL-13
            d) Anvil AS1902

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

    a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):

        1) Products:

            a) Anvil Fig. 86
            b) Eaton Fig. B3033/B3034
            c) nVent Model 300 & 310

b. Scissor Type Beam Clamps (for use with bar-joists and wide flange):

1) Products:

a) Anvil Fig. 228, 292
b) Eaton Fig. B3054
c) nVent Model 360

c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):

1) Products:

a) MCL. M1, M2 or M3

d. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-23. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

e. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

f. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 23 05 50 for additional requirements for concrete bases in seismic applications.
2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 6 inches on all sides of the equipment (6 inches larger than factory base), except where pad extension would interfere with working space at equipment control panels and electrical panels.
3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days (be 20 MPa strength).

5. Equipment requiring bases is as follows:
   a. Packaged Rooftop Units
   b. Chemical Feed Equipment
   c. Condensate Return Station
   d. Expansion Tank
   e. Heat Exchanger
   f. Pumps

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Government approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Government. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of the Contractor. Failure to coordinate openings shall not exempt the Contractor from providing openings at Contractor's expense.

E. Do not cut structural members without written approval of the Structural Engineer.

F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150°F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.5 ROOF PENETRATIONS

A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe and duct penetrations. Refer to drawings for details.

B. Conical Pipe Boot: Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color shall match roofing material.

C. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.6 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Structural Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. The Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

   a. The hanger is attached within 6" from a web/chord joint.
   b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel (Std. Weight or Heavier - Liquid Service):

a. Maximum Spacing:

1) 1-1/4" & under: 7'-0"
2) 1-1/2": 9'-0"
3) 2": 10'-0"
4) 2-1/2": 11'-0"
5) 3" and larger: 12'-0"

2. Steel (Std. Weight or Heavier - Vapor Service):

a. Maximum Spacing:

1) 1-1/4" and under: 9'-0"
2) 1-1/2": 12'-0"
3) 2" & larger: 12'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

a. Maximum Spacing:

1) 3/4" and under: 5'-0"
2) 1": 6'-0"
3) 1-1/4": 7'-0"
4) 1-1/2" 8'-0"
5) 2": 8'-0"
6) 2-1/2": 9'-0"
7) 3": 10'-0"
8) 4": 12'-0"
9) 6": 12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

a. Maximum Spacing:

1) 3/4" & under: 7'-0"
2) 1": 8'-0"
3) 1-1/4": 9'-0"
4) 1-1/2": 10'-0"
5) 2": 11'-0"
6) 2-1/2" & larger: 12'-0"

I. Installation of hangers shall conform to MSS SP-58, -69, and -89.

END OF SECTION 23 05 29

SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 23.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 3M

B. Bunting

C. Calpico

D. Craftmark

E. Emedco

F. Kolbi Industries

G. Seton

H. W. H. Brady

I. Marking Services.

2.2 MATERIALS

A. General:

1. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
2. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
3. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
4. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

B. Pipe Markers:

1. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

2. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
3. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

C. Hazardous System Maintenance Access Doors:

1. Access doors used to access equipment serving hazardous ductwork and filter systems shall be provided with a minimum 4" x 6" ANSI Z5353.2 biohazard warning label. Label shall read "WARNING - BIOHAZARD. ONLY AUTHORIZED PERSONNEL BEYOND THIS POINT".
2. Coordinate location of warning label with Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.
2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Government prior to ordering tags.
4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
5. Attach to handwheel or around valve stem.
6. Number all tags and show the service of the pipe.
7. Provide two sets of full size laminated piping floor plans and piping diagrams showing valve locations with respective tag numbers. Mount directory in location chosen by the Government.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment such as rooftop units, exhaust fans, filters, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:
1. STEAM - 50 PSI: Black lettering; yellow background
2. STEAM - 15 PSI: Black lettering; yellow background
3. HEATING WATER SUPPLY: White lettering; green background
4. HEATING WATER RETURN: White lettering; green background
5. MEDIUM PRESSURE CONDENSATE: Black lettering; yellow background
6. LOW PRESSURE CONDENSATE: Black lettering; yellow background
7. PUMPED CONDENSATE: Black lettering; yellow background

B. Steam pipe markers shall include operating steam pressure within pipes shown above.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.

B. Testing, adjusting, and balancing of heating systems.

C. Testing, adjusting, and balancing of plumbing systems.

D. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance, Seventh Edition.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.

D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.

E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.

F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.

G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing (latest edition).

H. TABB - International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

B. Electronic Copies:

1. Submit a certified copy of test reports to the Government for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
3. All text shall be searchable.
4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

1.5 REPORT FORMS

A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Government when needed to supply specified information.

B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

A. The Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.

B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Government prior to performing each test.

B. Project will be constructed in phases. Provide balancing report after each phase is complete.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.

B. The Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.

C. Recorded data shall represent actual measured or observed conditions.

D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

G. The Contractor shall measure terminal air box air flow, and shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.

H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

A. Before beginning work, verify that systems are complete and operable. Ensure the following:

1. General Equipment Requirements:

a. Equipment is safe to operate and in normal condition.
b. Equipment with moving parts is properly lubricated.
c. Temperature control systems are complete and operable.
d. Proper thermal overload protection is in place for electrical equipment.
e. Direction of rotation of all fans and pumps is correct.
f. Access doors are closed and end caps are in place.

2. Duct System Requirements:

    a. All filters are clean and in place. If required, install temporary media.
    b. Duct systems are clean and free of debris.
    c. Fire/smoke and manual volume dampers are in place, functional and open.
    d. Air outlets are installed and connected.
    e. Duct system leakage has been minimized.

3. Pipe System Requirements:

    a. Coil fins have been cleaned and combed.
    b. Hydronic systems have been cleaned, filled, and vented.
    c. Strainer screens are clean and in place.
    d. Shutoff, throttling and balancing valves are open.

B. Report any defects or deficiencies to Government.

C. Promptly report items that are abnormal or prevent proper balancing.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.

B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

A. ± 10% of scheduled values:

1. Adjust air inlets and outlets to ± 10% of scheduled values.
2. Adjust piping systems to ± 10% of design values.

B. ± 5% of scheduled values:

1. Adjust fume exhaust systems to ± 5% of scheduled values.
2. Adjust supply and exhaust air-handling systems for space pressurization to ± 5% of scheduled values, and to provide proper pressurization.

C. ± 5% of scheduled values

1. Adjust outdoor air intakes to within + 5% of scheduled values.

D. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

3.5 ADJUSTING

A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.

B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

D. The Contractor shall also be responsible for replacement sheaves.

E. The Contractor shall trim impeller to final duty point on all pumps not driven by a VFD.

3.6 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, utilize the building DDC system or install portable data loggers to simultaneously record temperatures and humidity during summer and winter conditions for a seven-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5F wet bulb temperature of maximum summer design condition and within 10F dry bulb temperature of minimum winter design condition.

B. The Government will direct all test locations.

C. Report of test results shall include original recording and three reproductions.

3.7 SUBMISSION OF REPORTS

A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 EXISTING SYSTEMS

A. Record the "as found" conditions and include them in the balance report as "existing." Make adjustments to the systems as required to get them to operate at maximum capacity and record them in report as "adjusted."

1. Existing Air Handling Units Suspended in Mechanical Room:

a. General Requirements:

1) Existing equipment description and location.
2) Location.
3) Manufacturer, model, arrangement, class, discharge.
4) Fan RPM.

b. Flow Rate:

1) Supply flow rate (cfm)
2) Return flow rate (cfm)
3) Outside flow rate (cfm)
4) Exhaust flow rate (cfm)

c. Pressure Drop and Pressure:

1) Filter pressure drop.
2) Total static pressure. (Indicate if across fan or external to unit).
3) Inlet pressure.
4) Discharge pressure.

2. Exhaust Fan

a. Drawing symbol.
b. Location.
c. Manufacturer and model.
d. Flow rate (cfm).
e. Total static pressure. (Indicate measurement locations).
f. Inlet pressure.
g. Discharge pressure.
h. Fan RPM.

3. Air Terminal (Inlet or Outlet):

a. Room number/location.
b. Terminal type and size.
c. Velocity.
d. Flow rate (cfm)
e. Percent of design flow rate.

4. Air Terminal Unit (Terminal Air Box) Data:

a. General Requirements:

1) Drawing symbol.
2) Location.
3) Manufacturer and model.
4) Size.
5) Type: constant, variable, single, dual duct.

b. Flow Rate:

1) Cooling maximum flow rate (cfm).
2) Heating maximum flow rate (cfm).
3) Minimum flow rate (cfm).
4) Water flow rate (gpm).

c. Temperature (heating and cooling):

1) Entering air temperature.
2) Leaving air temperature.
3) Entering water temperature.
4) Leaving water temperature.

d. Pressure Drop and Pressure:

1) Inlet static pressure during testing.
2) Coil air pressure drop.
3) Water pressure drop.

B. Report findings to Architect/Engineer on standard forms.

4.2 GENERAL REQUIREMENTS

A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (IMEG Corp.).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.3 AIR SYSTEMS

A. Duct Leakage Test:

1. Air system and fan.
2. Leakage class.
3. Test pressure.
4. Construction pressure.
5. Flow rate (cfm): specified and actual.
6. Leakage (refer to Section 23 31 00 in the specifications): specified and actual.
7. Statement that fire dampers, reheat coils and other accessories were included in the test.
8. Pass or Fail.
9. Test performed by.
10. Test witnessed by.

B. Air Moving Equipment:

1. General Requirements:

a. Drawing symbol.
b. Location.
c. Manufacturer, model, arrangement, class, discharge.
d. Fan RPM.
e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
f. Final frequency of motor at maximum flow rate (on fans driven by VFD).

2. Flow Rate:

a. Supply flow rate (cfm): specified and actual.
b. Return flow rate (cfm): specified and actual.
c. Outside flow rate (cfm): specified and actual.
d. Exhaust flow rate (cfm): specified and actual.

3. Pressure Drop and Pressure:

a. Filter pressure drop: specified and actual.
b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
c. Inlet pressure.
d. Discharge pressure.

C. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

D. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

E. Duct Traverse:

1. System zone/branch/location.
2. Duct size.
3. Free area.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Duct static pressure.
7. Air temperature.
8. Air correction factor.

F. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

G. Air Flow Measuring Station:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Size.
6. Flow rate (cfm): specified and actual.
7. Pressure drop: specified and actual.

H. Exhaust Hood:

1. Drawing symbol.
2. Location.
3. Manufacturer and Model.
4. Total flow rate (cfm): specified and actual.
5. Test velocities.
6. Hood opening dimensions.

I. Positive Air Flow Test:

1. Occupied Supply Air (Max./Min.) Flow rate (cfm): specified and actual.
2. Occupied Return Air (Max./Min.) Flow rate (cfm): specified and actual.

3. Unoccupied Supply Air (Max./Min.) Flow rate (cfm): specified and actual.
4. Unoccupied Return Air (Min./Max.) Flow rate (cfm): specified and actual.

4.4 HEATING SYSTEMS

A. Pump Data (Primary and Secondary Heating Water Pumps):

1. Existing drawing symbol or equipment TAG
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: Operating and shutoff.
8. Discharge Pressure: Operating and shutoff.
9. Final frequency of motor at maximum flow rate (on pumps driven by VFD).

B. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

C. Heat Exchangers:

1. General Requirements:

a. Drawing symbol.
b. Service.
c. Location.
d. Manufacturer and model.

2. Primary Heat Exchanger:

a. Steam pressure in exchanger: specified and actual.
b. Primary water entering temperature: specified and actual.
c. Primary water leaving temperature: specified and actual.
d. Primary water flow: specified and actual.
e. Primary water pressure drop: specified and actual.

D. Primary water Btuh (gpm x temperature drop x 500).Heating Coils:

1. General Requirements:

a. Drawing symbol.
b. Service.
c. Location.
d. Manufacturer and model.
e. Size.

2. Flow Rate:

    a. Flow rate (cfm): specified and actual.
    b. Water flow rate: specified and actual.

3. Temperature:

    a. Entering air temperature: specified and actual.0
    b. Leaving air temperature: specified and actual.
    c. Entering water temperature: specified and actual.
    d. Leaving water temperature: specified and actual.

4. Pressure Drop and Pressure:

    a. Air pressure drop: specified and actual.
    b. Steam pressure after valve: specified and actual.
    c. Water pressure drop: specified and actual.

5. Energy:

    a. Air Btuh (cfm x temp rise x 1.09).
    b. Water Btuh (gpm x temp drop x 500). Repeat tests if not within 10% of air Btuh.

E. Terminal Heat Transfer Units:

1. General Requirement:

    a. Drawing symbol.
    b. Location.
    c. Manufacturer and model.
    d. Include air data only for forced air units.

2. Flow Rate:

    a. Flow rate (cfm): specified and actual.
    b. Water flow rate (cfm): specified and actual.

3. Temperature:

    a. Entering air temperature: specified and actual.
    b. Leaving air temperature: specified and actual.
    c. Entering water temperature: specified and actual.
    d. Leaving water temperature: specified and actual.

4. Energy:

    a. Air Btuh (cfm x temperature rise x 1.09).
    b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

4.5 COOLING SYSTEMS

A. Cooling Coils:

1. General Requirements:

a. Drawing symbol.
b. Service.
c. Location.
d. Size.
e. Manufacturer and model.

2. Temperature:

a. Entering air DB temperature: specified and actual.
b. Entering air WB temperature: specified and actual.
c. Leaving air DB temperature: specified and actual.
d. Leaving air WB temperature: specified and actual.

3. Flow Rate:

a. Flow rate (cfm): specified and actual.

4. Pressure Drop and Pressure:

a. Air pressure drop: specified and actual.

5. Energy:

a. Air Btuh (cfm x enthalpy change x 4.5).
b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

B. Terminal Heat Transfer Units:

1. General Requirements:

a. Drawing symbol.
b. Location.
c. Manufacturer and model.
d. Include air data only for forced air units.

2. Temperature:

a. Entering air DB temperature: specified and actual.
b. Leaving air DB temperature: specified and actual.
c. Entering water temperature: specified and actual.
d. Leaving water temperature: specified and actual.

3. Flow rate:

a. Flow rate (cfm): specified and actual.
b. Water flow (gpm): specified and actual.

4. Energy:

   a. Air Btuh (cfm x temperature rise x 1.09).
   b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

4.6 PLUMBING SYSTEMS

A. Pump Data:

1. Drawing symbol.
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: operating and shutoff.
8. Discharge Pressure: operating and shutoff.

B. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, model, frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps for each phase.

C. Balancing Valve:

1. Drawing symbol.
2. Service.
3. Location.
4. Size.
5. Manufacturer and model.
6. Flow rate (gpm): specified and actual.
7. Pressure drop: specified and actual.

D. Electric Water Heater:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Capacity (KW): specified, nameplate, and actual.
6. Entering water temperature: specified and actual.
7. Leaving water temperature: specified and actual.
8. Pressure Drop: specified and actual.
9. Control Setting: specified and actual.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.

B. Materials:

1. Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
2. Fungal Resistance: No growth when tested in accordance with ASTM G21 (antifungal test).
3. Rated velocity on coated air side for air erosion in accordance with UL 181 at 5,000 fpm minimum.
4. UL listed in Category HNKT.

C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750C.

F. ASTM E814 - Fire Tests of Through Penetrations Firestops.

G. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

J. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

K. NFPA 255 - Surface Burning Characteristics of Building Materials.

L. UL - XHEZ - Through Penetration Firestop Systems.

M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

N. UL 263 - Full Scale External Fire Tests with Hose Stream.

O. UL 723 - Surface Burning Characteristics of Building Materials.

P. UL 1479 - Fire Tests of Through Penetrations Firestops.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and location.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.

B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75F; foil scrim Kraft facing, 3 lb./cu. ft. density.

C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75F; 1.5 lb/cu ft minimum density; coated air side for 5000 fpm air velocity.

D. Type E: Double wall ductwork insulation; fiberglass; 0.27 maximum 'K' value at 75F mean temperature; 1.5 lb/cu ft density.

2.2 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.

B. Install materials after ductwork has been tested.

C. Clean surfaces for adhesives.

D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.

E. Exterior Duct Wrap - Flexible, Type A:

1. Apply with edges tightly butted.
2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
3. Seal joints with adhesive backed tape.
4. Apply so insulation conforms uniformly and firmly to duct.
5. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.
6. Provide high-density insulation inserts on rectangular ducts at trapeze duct hangers to prevent crushing of insulation. Provide high-density insulation inserts with clamp-on round ducts requiring two (2) rods or straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
7. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
8. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
9. Staples may be used, but must be covered with tape.
10. Vapor barrier must be continuous.
11. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.

F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Interior Insulation - Flexible Duct Liner, Type C:

1. Observation of Duct Lining:

   a. After installation of ductwork, Architect/Engineer may select random observation points in each system.

      1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.
      2) Random observation points based on one opening per 75 lineal ft. of total duct run.

   b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.
   c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.
   d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 23 33 00.
   e. Paint or finish to match adjacent duct surfaces.

2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.
3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
4. Install per the latest edition of the SMACNA Manual.
5. Leading edges shall be covered as follows:

   a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.
   b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.
   c. Install metal nosing in the following locations (regardless of velocity):

      1) The first three fittings downstream of all fans.
      2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
      3) Trailing edges of transverse joints do not require metal nosings.

6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.
7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

H. Double-Wall Ductwork Insulation - Type E:

1. Install insulation per manufacturer's recommendations.
2. Duct dimensions given are net inside dimensions of inner wall.

I. Continue insulation with vapor barrier through penetrations unless code prohibits.

J. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

3.2 SCHEDULE

A. Refer to Ductwork Application Schedule in Section 23 31 00 for scheduling of insulation.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment Insulation.

B. Equipment Insulation Finishes.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate

C. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

E. ANSI/ASTM C534 - Elastomeric Foam Insulation

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ANSI/ASTM C553 - Mineral Fiber Blanket Thermal Insulation.

H. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

I. ANSI/ASTM C921 - Properties of Jacketing Materials for Thermal Insulation

J. ANSI/ASTM D1668 - Glass Fabric for Waterproofing

K. ASTM E84 - Surface Burning Characteristics of Building Materials.

L. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

M. NFPA 255 - Surface Burning Characteristics of Building Materials.

N. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for equipment scheduled.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type C: Glass Fiber Blanket; ANSI/ASTM C1393 Type IIIA Cat2; 0.40 maximum 'K' value at 300F; 2.5 lb/cu ft.; suitable to 850F, with all service jacket (ASJ) vapor retarder jacket having 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type D: Glass Fiber Board; ANSI/ASTM C612; 0.28 maximum 'K' value at 200F; 6.0 lb/cu ft; suitable to 850F, 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

C. Type E: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where thicker values are specified.

2.2 INSULATION FINISHES

A. Type 1: Glass Fabric; ASTM D1668, woven glass fabric with two coats of mastic approved for insulation type. Use vapor barrier mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures less than 70F and having maximum 0.013 perms/inch rating at 0.043 inch dry-film thickness when tested in accordance with ASTM E-96 Procedure B (Foster 30-80 or approved equivalent). Use breather mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures 70F or greater (Foster 35-00 or approved equivalent).

B. Type 2: All Service Jacket; ASTM C921; Factory or Field Applied; all-purpose polymer or polypropylene service jacket; Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Seal all joints with manufacturer approved tape and adhesive to maintain vapor barrier. Indoor use only, if used outdoors add type 4 finish.

C. Type 3: Flexible Elastomeric Thermal Insulation; After adhesive has fully cured, apply two coats of latex enamel paint approved by insulation manufacturer for outdoor use.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all materials per manufacturer's instructions, codes and industry standards.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

C. Do not insulate factory insulated equipment.

D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.

F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.

G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.

H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.

I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60F and/or above 100F. Verify insulation type and thickness with equipment manufacturer and Government.

J. Insulate all supports on equipment operating below ambient temperature.

3.2 INSULATION

A. Type C and D:

1. Apply with edges tightly butted and joints staggered.
2. Secure with welded pins and washers, 4" from each edge and 16" on center, or 1/2" x 0.015" galvanized steel bands, 12" on center.

B. Type E:

1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is greater than 1" thick.
2. Do not wrap sheet insulation around square corners, but cut and overlap insulation at corners to provide full insulation thickness on all sides. Seal all overlapping insulation surfaces with manufacturer approved adhesive.
3. Secure with manufacturer approved adhesive in accordance with installation instructions. Where applied to underside surfaces or on surfaces with temperatures 140F and above, cover all surfaces with full application of adhesive. Seal all joints and seams with manufacturer approved adhesive.

3.3 SCHEDULE

A. Steam-to-Water Heat Exchanger (up to 200F): 2" thick Type D; Finish 1 or 2.

B. Heating Water Air Separator/Coalescing Filter: 2" thick Type C, Finish 1 or 2.

C. Steam Condensate Receiver Tank: 2" thick Type D, Finish 1 or 2.

D. Flash Tank: 2" thick Type D, Finish 1 or 2.

E. Bypass (Pot Feeders):

1. Systems operating between 141F to 200F: 2" thick Type E, Finish 3.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

D. ANSI/ASTM C534 - Elastomeric Foam Insulation.

E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

H. ASTM E84 - Surface Burning Characteristics of Building Materials.

I. NFPA 255 - Surface Burning Characteristics of Building Materials.

J. UL 723 - Surface Burning Characteristics of Building Materials.

K. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

2.2 VAPOR BARRIER JACKETS

A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

B. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

2.4 REMOVABLE INSULATION JACKETS

A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.

B. Inner and outer covering shall be constructed from a minimum 16.5 oz./yd2 PTFE fiberglass composite and suitable for insulating surface temperatures up to 550°F.

C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:

1. Silica and glass-fiber insulation felts and blankets - minimum 6 lb./ft3 density.
2. E-type glass-fiber felts and blankets - minimum 6 lb./ft3 density.

D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550°F surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.

E. No raw cut jacket edges shall be exposed.

F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1" slide buckles.

G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.

H. Manufacturers:

1. Firwin Corp
2. Lewco Specialty Products
3. ThermaXX Jackets LLC
4. Approved equivalent

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
3. All balance valves and strainers with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 SUPPORT PROTECTION

A. Insulation with pipe size greater than 1-1/2” shall be protected from sagging and crushing by one the following means.

1. High Compressive Strength Insert: On all insulated piping greater than 1-1/2", provide shield with high compressive strength insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:

   a. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
   b. Provide metal shields between hangers or supports and the pipe insulation/insert. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

      1) Shields shall be at least the following lengths and gauges:

Pipe Size	Shield Size
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge
5" to 6"	18" long x 16 gauge
8" to 14"	24" long x 14 gauge
16" to 24"	24" long x 12 gauge

   c. Where rolled steel plate is noted above, provide minimum 1/4" rolled galvanized steel plates in addition to the shield as reinforcement on large pipes as noted above to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength.

2. Premanufactured shield/saddle for use with Elastomeric Foam (Type B): molded thermoplastic rigid pipe saddle sized for insulation outside diameter. Length as required by manufacturer.

B. Rectangular blocks, plugs, or wood material are not acceptable.

C. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

D. Neatly finish insulation supports, protrusions, and interruptions.

E. Ferrous hot piping 4 inches (100 mm) and larger, provide steel saddle at rollers as described in Section 23 05 29 "HVAC Supports and Anchors".

3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Exterior installations shall contain factory applied polymeric, moisture, and UV resistant covering with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:

    a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
    b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

4. Insulation Installation on Valves and Pipe Specialties:

    a. Install preformed sections of same material as straight segments of pipe insulation when available.
    b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
    c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3.5 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.

3. Interior joints do not need to be sealed.
4. Use metal covering on the following pipes:

    a. All exposed piping within greenhouse bays.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.
5. Use plastic insulation covering on all exposed pipes including, but not limited to:

    a. All exposed piping within 8'-0" of the floor (except for greenhouse bays that shall have aluminum jacketing throughout).
    b. All exposed piping within 8'-0" of the floor for the risers within the existing building going to the penthouse.
    c. All exposed piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

3.6 SCHEDULE

A. Refer to drawings for insulation schedule.

END OF SECTION 23 07 19

SECTION 23 09 00 - CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete System of Automatic Controls.

B. Control Devices, Components, Wiring and Material.

C. Instructions for Governments.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.

B. Company specializing in the work of this section with minimum five years temperature control experience.

C. Technician: Minimum five years' experience installing commercial temperature control systems.

D. Contractor is limited to firms regularly employing a minimum of five full-time temperature control technicians within 25 miles of the job site.

1.3 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/ASHRAE Standard 135-2020: BACnet® - A Data Communication Protocol for Building Automation and Control Networks, including all amendments.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).

E. ANSI/NFPA 70 - National Electrical Code.

F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

G. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

1.4 SUBMITTALS

A. Equipment Coordination:

1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
2. Control valve selections shall be based on flow rates shown in approved shop drawings.
3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Government for review.
2. Cross-reference all control components and point names in a single table located at the beginning of the submittal with the identical nomenclature used in this section.
3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.
4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.
5. Diagrams shall include:

    a. Wiring diagrams and layouts for each control panel showing all termination numbers.
    b. Schematic 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.
    c. Identification of all control components connected to emergency power.
    d. Schematic diagrams for all field sensors and controllers.
    e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
    f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.
    g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.
    h. All installation details and any other details required to demonstrate that the system will function properly.
    i. All interface requirements with other systems.

6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.

7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Government. Clearly highlight any deviations from the specified sequences on the submittals.
8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.
9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:

    a. Damper Identification Tag.
    b. Location.
    c. Damper Type.
    d. Damper Size.
    e. Duct Size.
    f. Arrangement.
    g. Blade Type.
    h. Velocity.
    i. Pressure Drop.
    j. Fail Position.
    k. Actuator Identification Tag.
    l. Actuator Type.
    m. Mounting.

10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:

    a. Valve Identification Tag.
    b. Location.
    c. Valve Type.
    d. Valve Size.
    e. Pipe Size.
    f. Configuration.
    g. Flow Characteristics.
    h. Capacity.
    i. Valve C_V.
    j. Design Pressure Drop.
    k. Pressure Drop at Design Flow.
    l. Fail Position.
    m. Close-off Pressure.

11. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
12. Provide PICS files indicating the BACnet functionality and configuration of each device.
13. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements if problems are found during BTL testing is required.
14. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.
15. Software: A list of operating system software, operator interface software, color graphic software, and third-party software.
16. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.
17. Clearly identify work by others in the submittal.
18. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.
2. Provide three complete sets of manuals.
3. Each O&M manual shall include:

    a. Table of contents with indexed tabs dividing information as outlined below.
    b. Definitions: List of all abbreviations and technical terms with definitions.
    c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.
    d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.
    e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.
    f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.
    g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
    h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.

i. Original Software: Complete original issue CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
j. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.
k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.

D. Training Manual:

1. Provide a course outline and training manuals for each training class.

E. Record Documents:

1. Submit record documentation per Section 23 05 00.
2. Provide a complete set of "as-built" drawings and application software on flash drives. Provide drawings as AutoCAD™ or Visio™ compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.
3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.
4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.
5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the Government verifying completion and proper operation of all points.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.6 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control Valves.

B. Flow Switches.

C. Temperature Sensor Sockets.

D. Gauge Taps.

E. Automatic Dampers.

F. Flow Meters.

1.7 AGENCY AND CODE APPROVALS

A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.

1. UL-916; Energy Management Systems.
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."
3. EMC Directive 89/336/EEC (European CE Mark).
4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.8 ACRONYMS

A. Acronyms used in this specification are as follows:

1. B-AAC BACnet Advanced Application Controller
2. B-ASC BACnet Application Specific Controller
3. BTL BACnet Testing Laboratories
4. DDC Direct Digital Controls
5. FMCS Facility Management and Control System
6. GUI Graphic User Interface
7. IBC Interoperable BACnet Controller
8. IDC Interoperable Digital Controller
9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

1.9 SUMMARY

A. Extend Existing System:

1. Extend the existing FMCS for this project.
2. All controllers and accessories shall interface with the existing FMCS.

B. Contractor shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Government.

D. The Government shall be the named license holder of all software associated with any and all incremental work on the project.

1.10 SYSTEM DESCRIPTION

A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.

B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Government's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.

C. Provide materials and labor necessary to connect factory supplied control components.

D. Provide central and remote hardware, software, and interconnecting wire and conduit.

E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Government.

F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

G. For each operator workstation provided, furnish one legal copy of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be readily available in the market. Contractor shall convey to the Government all software tools and their legal licenses at project closeout.

H. Niagara Framework (Definition):

1. Niagara Framework: A set of hardware and software specifications for building and utility control owned by Tridium Inc. and licensed to multiple vendors. The framework consists of front end (M&C) software, web-based clients, field level control hardware, and engineering tools.
2. Niagara Framework Supervisory Gateway: DDC hardware component of the Niagara Framework. A typical Niagara architecture has Niagara-specific supervisory gateways at the IP level and other (non-Niagara specific) controllers on field networks (TP/FT-10, MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara specific controllers function as a gateway between the Niagara framework protocol (Fox protocol) and the field network beneath. These supervisory gateways may also be used as general-purpose controllers and also have the capability to provide a web-based user interface. Note that different vendors refer to this component by different names. The most common name is "JACE", which is used in this specification generically; other names include (but are not limited to)"EC-BOS", "FX-40", "TMN", "SLX" and "UNC".

I. Connection:

1. System shall be a complete hard-wired system. Wireless control systems/functions are NOT acceptable.

1.11 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is the Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.12 WARRANTY

A. Refer to Section 23 05 00 for warranty requirements.

B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Government.

C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

D. Update all software and back-ups during warranty period and all user documentation on the Government's archived software disks.

1.13 WARRANTY ACCESS

A. The Government shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Following is the existing BAS used throughout the existing facility that shall also be used for this project:
1. Siemens Building Technologies

2.2 NETWORK AREA CONTROLLER (NAC)

A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall determine the quantity and type of devices.

B. NAC shall be provided with open connectivity to any manufacturer's BACnet programmable or application specific direct digital controllers. These controllers shall be JACE 8000 Series models or the identical hardware private label equivalent. The programmable controllers and application specific controllers provided under this section shall be able to be programmed by their respective engineering software application tools through the Niagara-based supervisory controllers from the Ethernet level network. The engineering software application tools shall be able to be loaded on a personal computer with Ethernet connectivity, and no additional hardware shall be required to connect to and download any programmable or application specific controller.

C. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of all controller data.
7. Network Management functions.

D. The Network Area Controller shall provide the following hardware features as a minimum:

1. One Ethernet Port - 10/100 Mbps.
2. One RS-232 port.
3. One LonWorks Interface Port - 78KB FTT-10A (for LonWorks systems only).
4. One RS-485 port.
5. Battery backup.
6. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity.)
7. The NAC must be capable of operation over a temperature range of 32F to 122F.
8. The NAC must be capable of withstanding storage temperatures of between 0F and 158F.
9. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.

E. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data stored within it.

F. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5) simultaneous users.

G. Event Alarm Notification and Actions:

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a LAN, remote via dial-up telephone connection, or WAN.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:

    a. Alarm
    b. Normal

4. Provide for the creation of a minimum of eight alarm classes with different routing and acknowledgement properties, e.g. security, HVAC, Fire, etc.
5. Provide timed (scheduled) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

H. Treat control equipment and network failures as alarms and annunciated.

I. Annunciate alarms in any of the following manners as defined by the user:

1. Screen message text.
2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-mail alarms based on:

    a. Day of week.
    b. Time of day.
    c. Recipient.

3. Pagers via paging services that initiate a page on receipt of e-mail message.
4. Graphic with flashing alarm object(s).
5. Printed message, routed directly to a dedicated alarm printer.

J. The FMCS shall record the following for each alarm:

1. Time and date.
2. Location (building, floor, zone, office number, etc.).
3. Equipment tag.
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

K. Give defined users proper access to acknowledge any alarm.

L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a "query" feature to allow review of specific alarms by user-defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An error log to record invalid property changes or commands shall be provided and available for review by the user.

2.3 GRAPHIC USER INTERFACE COMPUTER HARDWARE (DESKTOP)

A. Provide browser workstation in the new headhouse at location designated by Government. Provide metal computer desk and office chair with casters and adjustable height and arms.

B. Provide a browser workstation with a High-Mid Range CPU as defined by www.cpubenchmark.net with Intel or AMD processor and SSD hard drive of at least 1-terabyte minimum hard drive and 32.0 GB RAM. It shall include one parallel port, one asynchronous serial port, HDMI, and three USB ports and three USB-C ports. Include a 27" minimum flat panel color monitor, 8ms response time.

C. The workstation operating system shall be the latest version of Microsoft Windows and Microsoft internet browser.

D. Connect to the FMCS network via a 1 Gbps Ethernet network interface card.

E. Provide a color laser printer with minimum 600 x 600-dpi resolution and 12 PPM print speed.

2.4 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. A UPS shall be provided for each of the following:

1. FMCS workstations and servers.
2. Network area controllers.

B. Provide a 120-volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for two (2) minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.

C. Manufacturers:

1. Sola/Hevi-Duty
2. Eaton Powerware
3. APC

2.5 VARIABLE FREQUENCY DRIVES

A. Power connection between VFD and motor shall be by EC. Coordinate feeder and raceway installation with EE.

2.6 CONTROL DAMPERS

A. Rectangular Control Dampers - Standard Construction:

1. Shall be licensed to bear the AMCA Certified Rating Seal.
2. Test leakage and pressure drop per AMCA 500.
3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.

4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).
5. Shaft: Non-cylindrical, solid stainless steel with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.
8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
11. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8000 CFM through a 24" x 24" damper (2000 fpm).
13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8000 CFM through a 24" x 24" damper (2000 fpm).
14. Acceptable Manufacturers:

    a. Tamco 1500 Series
    b. Arrow AFD-20

B. Thermally Insulated Control Damper:

1. Shall be licensed to bear the AMCA Certified Rating Seal.
2. Test leakage and pressure drop per AMCA 500.
3. Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness.
4. Thermally Broken Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness, flanged to duct. Entire frame shall be thermally broken using polyurethane resin pockets, complete with thermal cuts.
5. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).
6. Shaft: Non-cylindrical, solid stainless steel shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
7. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
11. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
12. Maximum Pressure Drop: 0.21" for 8000 CFM through a 24" x 24" damper (2000 fpm).
13. Acceptable Manufacturers:
    a. Tamco 9000SC / BF

2.7 DAMPER ACTUATORS

A. Damper Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Dampers: Where shown on the drawings or sequences, fail-safe mechanism shall operate the damper to the fail position following power interruption.

    a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
    b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0% and 100% in 10 percent increments with a 10 second operational delay.
5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.
6. Damper End Switches: Where shown on the drawings or sequences, provide end switches to prove damper reaches open/closed position.

2.8 HYDRONIC CONTROL VALVES

A. General:

1. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 1 psi.
2. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 4 to 5 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 4 psi.
3. Modulating two-way valves shall have equal percentage flow characteristics.

4. Modulating three-way valves shall have linear flow characteristics.
5. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Modulating:

1. Ball 2" and under:

a. Design Pressure: 400 psi

1) Design Temperature: 250F
2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: 0%

b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, EPDM, PTFE or RTFE seats and seals, PTFE characterizing disc, screwed ends.

2. Ball 2-1/2" to 6":

a. Design Pressure: 200 psi

1) Design Temperature: 212F
2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: 0%

b. Cast iron body GG25, stainless steel stem, stainless steel ball, EPDM, PTFE or RTFE seats and seals, stainless steel characterizing disc, flanged ends.

2.9 STEAM CONTROL VALVES

A. General:

1. Two-position valves shall have a maximum pressure drop equal to 10% of the inlet pressure.
2. Two modulating control valves in parallel shall have 1/3 - 2/3 capacities sequenced so that the smaller valve opens first.
3. The pressure drop through a modulating control valve with an inlet pressure less than or equal to 15 psig shall be equal to 80% of the inlet pressure. In no case shall the inlet pressure of the equipment after the valve be less than 2 psig, except for integral face and bypass coils where the inlet pressure after the valve shall not be less than 5 psig.
4. The pressure drop through modulating control valves with inlet pressures greater than 15 psig shall be equal to 42% of the inlet pressure but shall be required to provide outlet pressure of 1 psi above the scheduled or specified inlet pressure of the equipment served.

B. Two-Position or Modulating (Low Pressure: 15 psi or below):

1. Globe 1/2" to 2":

a. Design Pressure: ANSI Class 250

1) Design Temperature: 338F

2) Design Flow Differential Pressure Rating: 35 psi
3) Leakage: ANI Class VI

b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel plug and seat; PTFE or RTFE packing; threaded ends.
c. Flow Characteristic: Equal percentage.

2. Globe 2-1/2" to 6":

a. Design Pressure: 125 psi

1) Design Temperature: 337F
2) Design Flow Differential Pressure Rating: 50 psi
3) Leakage: ANSI Class III

b. Bronze body, stainless steel trim, seat and plug; stainless steel stem; PTFE or RTFE packing; threaded ends.
c. Flow Characteristic: Linear.

2.10 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.
2. Provide visual position indication.
3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Valves: Where shown on the drawings or sequences, fail-safe mechanism shall operate the valve to the fail position following power interruption.

a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0% and 100% in 10 percent increments with a 10 second operational delay.

5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.

2.11 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5F, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.
b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5F, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element can trigger the switch.
b. Provide 3" minimum radius capillary support clips at each turn.
c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.
d. Setpoint range shall be 15F to 55F, with a permanent stop at 35F.
e. Differential shall be fixed at approximately 5F and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

a. Sensor Only: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, no setpoint adjustment or override button.
b. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a single warmer/cooler or red/blue visual scale), no override button.
c. Sensor with Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.
d. Sensor with Setpoint Adjustment and Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

   a. RTD type averaging sensor. 1000 ohm platinum RTD; accuracy: minimum ± 1.2F; range -40F to 220F.
   b. Sensing element shall have a minimum of 1 foot of sensor length for each 2 square feet of duct or coil area. Sensor shall be arranged evenly across the duct or coil such that no point in the duct or coil is more than 1 foot away from the sensor.
   c. Probe type thermistors are acceptable in VAV box duct applications downstream of reheat coils.

3. Water Temperature Sensor:

   a. RTD type. 1000 ohm platinum RTD; accuracy: minimum ± 0.65F; range -40F to 220F.
   b. Thermowell: RTD must be installed within a 316 stainless steel thermowell using a non-hardening heat conducting paste. Thermowell shall be rated for a minimum static pressure of 500 psig at the maximum operating temperature and be capable of withstanding water velocities of up to 27 fps. The sensor shall be mounted so that it extends into the flow stream to a minimum of 1/3 of the diameter of the pipe. For pipes greater than 10 inch diameter, thermowell shall be installed in a position 45 degrees from the bottom of the pipe. Separate thermometers, as specified elsewhere, shall be installed within 2 feet of each temperature sensor.

C. Humidity Measuring Devices:

1. Humidity Sensors:

   a. Room Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH humidity at temperatures from 50F to 104F.
   b. Room Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.
   c. Duct Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.

2. Humidistats:

   a. Room Humidistats: Wall-mounted, proportioning type, with adjustable 2% RH throttling range, operating range from 30% to 80% at temperatures up to 100F, cover with concealed setpoint. Accuracy shall be minimum of 1.5 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH at temperatures from 50F to 104F.
   b. High Limit Duct Humidistat: 2-position insertion type, with differential maximum 2% RH.

3. Combination Room Temperature/Humidity Sensors:

   a. Wall-mounted two-piece construction, plastic enclosure, off-white color with temperature and humidity measurement, exposed single setpoint adjustment and occupant override. Large display with temperature and %RH readout display, occupied/unoccupied override button with LED**,** and membrane keypad and gasketing for wipe-down cleaning.

   b. Temperature Component: Thermistor sensing element or resistance temperature device (RTD), 45F to 90F operating range, ± 0.50F accuracy.

c. Humidity Component: Proportioning type, with adjustable 2% RH throttling range, operating range from 0% to 90% at temperatures up to 110F. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH.

4. Combination Duct Temperature/Humidity Sensors.

a. Duct mounted: Multi-function humidity device. Duct humidity limiter with integral temperature sensor. Proportionately reduce its output signal to the humidification equipment as duct relative humidity (RH) approaches user-defined setpoint. Initial setpoint shall be 85%RH (ADJ.). Single-pole, single-throw normally open relay contact for on/off and alarm indication. 0-10VDC or 0-20mA AC

b. Temperature Component: Thermistor sensing element or resistance temperature device (RTD), 1,000 ohm at 0F, 32F to 120F operating range, ± 0.50F accuracy.

c. Humidity Component: Polymer element, Proportioning type, with adjustable 2% RH throttling range, setpoint 60% to 95% at temperatures up to 150F. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH.

D. Enthalpy Sensors: Duct-mounted enthalpy sensor shall include solid state temperature and humidity sensors with electronics that shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

E. Pressure Measuring Devices

1. Differential Pressure Switches:

a. Standard Pressure Switches:

1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
2) Accuracy shall be ± 3% of full scale maximum throughout entire range at 70F.
3) Provide mounting brackets, probes, and shutoff valves required for proper installation.
4) The range and service shall be as required for application or as noted on the drawings.
5) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.
6) Provide latching relays that require manual reset once activated.
7) Acceptable Manufacturer: Dwyer Photohelic Series 3000.

2. Pressure Transmitters/Transducer:

a. Air-to-Air:

1) Provide transducer having the following minimum performance for measuring duct static pressure for VFD control or measuring differential pressure across filter banks:

a) Accuracy: ± 1.0% FS
b) Non-Linearity, BFSL: ± 0.96% FS

c) Hysteresis: 0.10% full scale
d) Non-Repeatability: 0.05% full scale
e) Thermal Effects (compensated range): 0F to +150F
f) Maximum Line Pressure: 10 PSI
g) Zero/Span Shift: 0.033%FS/F
h) Long Term Stability: 0.5%FS/1year

2) Provide transducer with the following minimum performance for measuring differential pressure across piezometer fan inlet airflow measuring stations:

a) Unit shall come factory equipped with static tube attached.
b) Unit shall include: (1) LCD shall display differential pressure on face of sensor enclosure over the entire operational range, and (2) IPCC-rated polycarbonate enclosure with short circuit proof outputs and reverse polarity protected inputs.
c) Accuracy at 72F: ± 0.25% FS
d) Stability: ± 0.25% full scale per year
e) Temperature Error: (1) Zero: ± 0.025% full scale per C, (2) Span: Maximum ± 0.03% full scale per C
f) Environmental Operating Range: 32F to 140F.
g) Overpressure: Proof: (1) 2 psi, (2) Burst: 3 psi
h) Humidity: 0% to 95% RH non-condensing.

b. Wet-to-Wet (uses include measuring hydronic system differential pressure for VFD control):

1) Unidirectional pressure range selected for appropriate range based on the application.
2) Provide transducer with minimum 250 psi high side proof pressure and minimum 60 psi low side proof pressure.
3) Case shall be constructed of stainless steel/aluminum and shall be equipped with 1/4" threaded connections. Wetted parts shall be constructed of 300 series stainless steel. Provide transducer with Viton and silicone O-rings for solutions containing water and/or glycol. Provide transducer with Buna-N O-rings for hydrocarbon solutions.
4) Provide transducer with factory assembled 3-valve manifold assembly to allow for field calibration of transducer.
5) Performance shall be as follows:

a) Accuracy: ± 0.25% F.S.
b) Non-Linearity: ± 0.20% F.S.
c) Hysteresis: 0.10%F.S.
d) Non-Repeatability: 0.05% F.S.
e) Compensated Temp Range: +30F to +150F
f) Long Term Stability: 0.5% F.S./year

c. Saturated Steam:

1) 316 stainless steel pressure transmitters suitable for use with saturated steam and with minimum 200% proof pressure and 800% burst pressure. Provide with 17-4 PH stainless steel wetted parts (diaphragm).

2) Performance shall be as follows:

a) Pressure Range: 0-150 psig
b) Accuracy: ± 1.0% F.S.
c) Thermal Effect: ± 0.04% F.S./F zero and span
d) Compensated Temp Range: -20F to 160F
e) Operating Temp Range: -40F to 200F
f) Long Term Stability: 0.5% F.S./Year

3) Provide with pigtail syphon and stainless-steel pressure snubber.
4) Manufacturer:

a) Kele PTX1
b) or approved equivalent

3. Greenhouse Bay Temperature, Humidity and CO2 Transmitter and Sensors
a. General:
1) Provide a temperature, humidity, and CO2 transmitter for each greenhouse bay complete with cabling and sensors.
2) Mount the transmitter on the wall of the greenhouse bay. Coordinate the exact mounting location with the Government Representative.
3) The temperature, humidity, and CO2 probes shall be mounted above the center of the greenhouse bay so that it will be above the corn or wheat plants. Coordinate the exact mounting location and height with the Government Representative.
b. Transmitter:
1) General:
a) Provide transmitter in each greenhouse bay along with cabling for remote temperature/humidity and CO2 probes.
b) Provide wiith low voltage control transformer.
c) Coordinate the exact placement of the transmitter and associated devices with the Government Representative prior to installation.
d) The system shall continuously measure, display, and monitor the room temperature, humidity and CO2 level.
e) All components of the room pressure monitor system shall be completely designed, tested, cataloged, and coordinated for single point responsibility.

f) Furnish and install all wiring as required to connect system components. All wiring shall be installed in conduit.
2) Transmitter Options:
a) Capacitive touchscreen display
b) Powering: Protective extra-low voltage (15 - 35V DC, 24V AC +/-20%) or AC (mains) power (100 - 240V AC 50/60 Hz)
3) Mechanical Specifications:
a) Housing classification: IK08, DIN EN ISO 11997-1: Cycle B (VDA 621-415)
b) Housing material: AlSi10Mg (DIN 1725)
c) Display window material: Strengthened glass (IK08)
d) Weight: 3.3 lb
e) Dimensions: 5.63" x 7.17" x 2.64"

4) Operating Environment:
   a) Operating environment: Outdoor use, wet location
   b) Operating humidity: 0 - 100% RH
   c) Maximum operating altitude, AC (mains) power: 9800 ft.
   d) IP rating: IP66
   e) 50E rating: Type 4UL
   f) Operating temperature with display: -40F to +131F
   g) Storage temperature with display: -22F to +140F

c. Inputs and Outputs:
   1) Analog input:
      a) Available ranges: 4 - 20 mA
      b) Resolution: 6 µA
      c) Display resolution: 0.01 mA
      d) Accuracy: +/-0.05 mA
      e) Input impedances: 200 Ω
      f) Isolation: Isolated from power supply
      g) Overload protection: 40 mA max. (reverse polarity protected)
   2) Analog outputs:
      a) Number of analog outputs: 4
      b) Isolation: Isolated from power supply
      c) Selectable voltage output types: 0 - 1 V, 0 - 5V, 0 - 10V, scalable
      d) Selectable current output types: 4 - 20 mA, 0 - 20 mA, scalable
      e) Max. wire size: 14 AWG
      f) Accuracy of analog outputs at 68F: +/-0.05% full scale
      g) Temperature dependence: +/-0.005% / degrees C full scale
   3) Relay Outputs:
      a) Number and type of relays: 2 pcs, SPDT
      b) Max. switching power, current voltage: 30W, 1A, 40V DC / 28V AC
      c) max. wire size in PELV version: 14 AWG
      d) Max. wire size in AC (mains) version: 16 AWG
   4) Ethernet interface:
      a) Supported standards: 10BASE-T, 100BASE-TX
      b) Connector: 8P8C (RJ45)
      c) Supported protocols: Modbus TCP/IP (port 502), HTTPS (port 8443)
   5) Acceptable Manufacturers:
      a) Vaisala Indigo 520 or pre-approved equivalent.

d. Humidity and Temperature Probe:
   1) Relative Humidity:
      a) Relative humidity range: 0 - 100% RH
      b) Accuracy at 73.4F: +/-0.8% RH (0 - 90% RH)
      c) Factory calibration uncertainty: +/-0.5% RH (0 - 40% RH), +/-0.8% RH (40 - 90% RH)
      d) Response time: 15 seconds
   2) Temperature:
      a) Sensor: Pt100 RTD Class F0.1 IEC 60751
      b) Measurement range: -40F to +248F
      c) Accuracy: +/-0.18F
      d) Factory calibration uncertainty: +/-0.18F at 73.4F

3) Inputs and Outputs:
   a) Operating voltage: 15 - 30 V DC
   b) Current consumption: 10 mA typical, 500 mA max.
   c) Digital output: RS-485, non-isolated
   d) Protocols: Modbus RTU
4) Output Parameters:
   a) Absolute humidity (g/m3) / Relative Humidity (% RH)
   b) Absolute humidity at NTP (g/m3) / Relative humidity (dew/frost) (% RH)
   c) Dew point temperature: (degrees C) / Temperature (degrees C)
   d) Dew/frost point temperature at 1 atm (degrees C) / Water concentration (set basis) (vol-%)
   e) Dew point temperature difference (degrees C) / Water pressure vapor (hPa)
   f) Enthalpy (kJ/kg) / Water vapor saturation pressure (hPa)
   g) Mixing ratio (g/kg) / Wet-bulb temperature (degrees C)
5) Operating Environment:
   a) Operating temperature of probe body: -40F to +176F
   b) Operating temperature of probe head: -40F to +248F
   c) Operating humidity of probe head: Max. 212F
   d) Operating environment: Suitable for outdoor use.
   e) Measurement environment: For air, nitrogen, hydrogen, argon, helium, and oxygen.
   f) IP rating of probe body: IP66
6) Mechanical Specifications:
   a) Connector: M12 5-pin A-coded male
   b) Weight (with a 2 meter cable): 10.65 oz.
   c) Probe cable length: 10 meters
   d) Probe material: AISI 316L
   e) Probe body: AISI 316L
   f) Cable jacket: FEP
7) Accessories:
   a) Solar radiation shield: DTR502B
   b) Cable gland M20x1.5 with split seal: HMP247CG
   c) Magnetic probe holder: ASM213382SP
   d) USB adapter: USB2
8) Acceptable Manufacturer:
   a) Vaisala HMP3 or pre-approved equivalent.

e. Carbon Dioxide (CO_2) Probe:
1) Measurement performance:
   a) 0 - 10,000 ppm CO_2 (up to 30,000 ppm with reduced accuracy)
2) Accuracy:
   a) 0 - 3000 ppm: +/-40 ppm
   b) 3000 - 10,000 ppm: +/-2% of reading
   c) Up to 30,000 ppm: +/-3.5% of reading
3) Calibration uncertainty:
   a) at 2000 ppm: +/-31 ppm
   b) at 10,000 ppm: +/-105 ppm
4) Long term stability:
   a) 0 - 3000 ppm: +/-60 ppm / year
   b) 3000 - 6000 ppm: +/-150 ppm / year
   c) 6000 - 10,000: +/-300 ppm / year

5) Inputs and Outputs:

a) Analog outputs: 0 - 5/10V (scalable), 0/4 - 20 ma
b) Digital output: Over RS-485: Modbus
c) Operating voltage: with digital output or voltage output in use 12 - 30V DC, with current output in use 20 -30V DC

6) Operating Environment:

a) Operating temperature: -40F to +140F
b) Storage temperature: -40F to +158F
c) Operating humidity: 0 - 100% RH, non-condensing
d) Condensation prevention: Sensor head heating when power on
e) Chemical tolerance (temporary exposure during cleaning): H_2O_2 (2000 ppm, non-condensing), alcohol-based cleaning agents (for example ethanol and IPA), acetone, acetic acid.
f) IP rating of probe body: IP66

7) Acceptable Manufacturers:
a) Vaisala GMP252 or pre-approved equivalent.

4. Room Temperature, Humidity and Pressure Monitoring System
a. General:

1) Provide room temperature, humidity, and pressure monitoring system in each greenhouse bay and the headhouse. Each monitoring system shall include a room pressure monitor, remote pressure sensor, door switch, and low voltage control transformer.
2) Coordinate the exact placement of the monitoring panel and associated devices and tubing with Government Representative prior to installation.
3) The system shall continuously measure, display, and monitor the room pressure, temperature and humidity.
4) All components of the room pressure monitor system shall be completely designed, tested, cataloged, and coordinated for single point responsibility.
5) Furnish and install all wiring as required to connect system components. All wiring shall be installed in conduit.

b. Software Monitoring Operation:

1) The Device is capable of monitoring the differential pressure between three individual spaces at all specified locations on the drawings.
2) The display has the capability to show up to three rooms individually, or together on one screen.
3) Each of the three rooms may show up to 6 parameters. The standard parameters available for selection are room differential pressure, temperature, relative humidity, and air changes per hour (also known as air change rate, or ACH). Two optional user-defined parameters may be displayed.
4) The two user-defined parameters accept most sensors including light, sound, airflow velocity, gases (CO_2), particle mass (PM2.5 or similar) via either electrical or BACnet input signals.

5) The display has the capability to show the following parameters together on a single screen:
   a) Room nam
   b) Up to 4 user-defined room Profiles (or modes), with an addition to STANDBY
   c) Full-screen mode selection, which causes the display to show all rooms simultaneously on one screen
   d) Configuration mode selection, to define the operation of the Device
   e) A banner indicating NORMAL, WARNING, ALARM, and STANDBY modes. During ALARM mode, the entire display background turns red.
   f) Alarm delay period, selectable from 0-9999 seconds
   g) Alarm silence period, selectable from 0 to infinite
   h) One-touch disable of all alarm functions
   i) Room icon, intended to provide a visual depiction of the room's use
   j) Two lines of user-defined text, intended to inform staff of the room's use
   k) Icons which appear to indicate alarm, silence, door, or reset functions
   l) A choice of 3 screen background colors; green, blue, and purple
   m) Up to 6 environmental parameters per room, total of 18, noted above
6) Each Device has two levels of password protection; Operator and Supervisor, which will limit permission to access levels of functionality. Key switches as methods of security are not acceptable. Out of the box, a supervisor passcode must be entered in order to configure the unit.
7) Each Device has the ability to be set in Negative, Positive, or Neutral status enabled through alarm setup. Key switches to change room mode are not acceptable.
8) When configured with an on-board differential pressure sensor, each Device is able to be calibrated through the touch screen interface with simultaneous access to the on-board sensor module and corresponding output signal.
9) Each Device has the option to communicate on either BACnet MS/TP networks or BACnet/IP networks. When using BACnet/IP, either static IP or Dynamic Host Control Protocol (DHCP) may be used.
10) Each Device has the ability for the setup to be cloned, so that the settings can be copied and uploaded to each Device in the facility if desired. This is to be done through a standard USB connection.
11) Each Device has the ability for the setup to be network-configured, so that the settings can be copied and uploaded to each Device in the facility if desired. This is to be done through either a BACnet MS/TP network or BACnet/IP network.
12) Any function that can be configured via the touch display interface can also be configured over the network via BACnet protocol. Exceptions include changing Operator or Supervisor passwords, Device ID, and other read-only attributes.
13) A secondary Device may operate as a slave, or duplicate display, whereby functions of the master Device are mapped via BACnet objects from one Device to the other. In this manner, one Device may monitor and alarm on the parameters of the other Device.
14) Each Device has the ability to diagnose the BACnet network by a) sending a who-is command and b) looking at specific features of an active BACnet network / statistics.

c. Software Control Operation:
   1) The Device is capable of performing equipment control operation using a Proportional-Integral (PI) control loop that drives on-board or external analog output and relay.
   2) The Device is capable of performing equipment control operation by read/write control of BACnet objects on the network (BACnet Setpoint Override), mapping

control points from other Devices or third-party controllers. Three independent control functions operate in this manner.

3) Any of the 6 environmental parameters per room, total of 18, can be configured for control operation.

4) BACnet Setpoint Override allows for both override setpoint changes and duration of setpoint override.

d. Mechanical and Electrical Operation:

1) The Device utilizes a direct pressure sensing device for differential pressure measurement; flow-through technologies (i.e. hot wire anemometers) that require frequent cleaning are not acceptable. The Device has an internal pressure sensor as well as the capability to use an external (remote) pressure sensor input. Each Device must be provided with a NIST-traceable calibration certificate for the differential pressure sensing element.

2) The on-board or external differential pressure sensor is a capacitive-based transducer, with bi-directional ranges from ±0.05" WC (±12.5 Pa) to ±1.0" WC (±250 Pa). Performance characteristics are that the sensor has an Accuracy RSS ±0.25% of full-scale, Non-linearity by Best Fit Straight Line (BFSL) method ±0.24%, Hysteresis ±0.05%, Non-repeatability ±0.05%, Span Setting Tolerance ±0.5% Rdg, Zero/Span Shift ±0.03% of full-scale.

3) The differential pressure sensor is dead-ended in design, where tubes and the sensing element require no cleaning for continuous reliable operation.

4) Each Device is provided with a 3-inch anti-kink tubing section for each remote pressure pickup port.

5) Each Device has the option of either an internal differential pressure sensor, or external differential pressure sensor, with the ability to send an analog output of 4 to 20 mA, 0 to 5 VDC, or 0 to 10 VDC to a system controller. A 250-ohm precision resistor is needed for the 4-20 mA sensor input. The device has a display resolution of 0.0001" WC.

6) Each Device has a 7" projected-capacitive display, dimmable, full color touch-screen display with an 800x600 resolution, capable of use with medical gloves. The brightness of the display has 5 levels from dim to bright, with an ability to control brightness over the BACnet network. The Device also has a 'black room' feature which will turn the screen to black until the end user touches the screen, useful for example in vivarium applications.

7) Each Device can be set up with time and date manually or via BACnet time synch feature. The time and date can be enabled to be viewed on the main display.

8) Each Device can use one of the configurable analog inputs in digital mode to represent a NO or NC switch to indicate door open / closed status. Once configured and the door is open, a small door icon will appear showing the door is open. The Device can only support one digital door status input so if the user wishes to configure more than one door, the switches must be daisy chained.

9) Each Device is flush mount design and installed in a standard off-the-shelf electrical wall box with no visible external fasteners; visible screw heads are not acceptable. Stand-off from the wall surface does not exceed 0.72".

10) The Device is configured with dual audible alarm buzzers which can be enabled / disabled by user configuration.

11) The Device shall has on-board inputs and outputs, including 3 universal inputs, 1 analog input, 1 analog output, and 1 relay output.

12) All connectors for wiring are removable, for convenience of installation.

13) Power is either 24 volts AC or DC, compliant with full operation in the range of 18-32 volts.

14) Ingress Protection (IP) rating is IP-65.
15) The Device depth within the wall cavity does not exceed 50 mm

e. Door Switch:
1) Magnetic door switch designed to interface with room pressure monitor.

f. Transformer:
1) The transformer shall have a primary-side voltage of 120 VAC and a secondary-side voltage of 24 VAC.
2) The transformer shall be UL and CSA listed.
3) Manufacturer shall provide cable between the transformer and room pressure monitor.

g. Acceptable Manufacturers:
1) Setra FLEX or pre-approved equivalent.

F. Flow Measuring Devices:

1. Flow Switches:

a. Suitable for the intended application (water or air system).
b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap switch.

G. Current Measuring Devices:

1. Current Switches for Constant Speed Motors:

a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.

2. Current Switches for Motors Controlled by VFD:

a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.

H. Carbon Dioxide Sensors:

1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO_2 with ± 100 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas

permeable membrane that prevents particulate contamination of the sensor. Unit shall have selectable IAQ mode with output signal and sum of CO2 and VOC levels.

I. Miscellaneous Devices:

1. Application Specific Controller Power Supply:

   a. Provide multiple enclosures with the following accessories and components as required to provide 24VAC power to differential pressure monitors, damper actuators, valve actuators, and other components and devices as required.
   b. NEMA-1 steel enclosures (12"x12"x6") with separate high and low voltage compartments and separate access covers.
   c. Either one 300 VA power supply with three 100 VA Class 2 outputs, or one 500 VA power supply with five 100 VA Class 2 outputs.
   d. Primary side shall receive 480/277/240/120 input to 24 VAC ungrounded, isolated output on the secondary side.
   e. Each secondary output shall include a 4 amp breaker, on/off switch, and LED indicator. Terminal blocks shall accept 16-22 AWG wire.
   f. Acceptable Manufacturer:

      1) RIB Functional Devices Model MSH300A-LVC or PSH500A-LVC

2. Control Relays:

   a. Form "C" contacts rated for the application with "push-to-test" contact transfer feature and an integral LED to indicate coil energization.
   b. Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or controlled device and clearly label their functions.

3. Thermostat and Sensor Enclosures:

   a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on the drawings.
   b. Heavy Duty Enclosure:

      1) Perforated steel, tamperproof locking thermostat and control device enclosure.
      2) Box shall be nominally 8"x6"x2" deep or sized as required to fit devices to be enclosed.
      3) Perforated cover shall be 16 gauge steel with maximum 3/16" perforations on maximum 1/4" staggered centers for a 55% free area.
      4) Secure to wall from inside of box. Cover shall be secured by tamperproof screws to frame.
      5) Color shall match electrical devices. Verify color with the Electrical Contractor.

4. Twist Timers:

   a. Wall-mounted heavy duty, with rotary dial and face graduated in minutes or hours as noted. Unit shall fit behind standard "decorator" wall plate. Color of timer and face plate shall match

remainder of project. Verify with Electrical Contractor. Provide wall plate and engraved plastic label indicating service.

b. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-1/2" deep electrical box.

c. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.

d. Manufacturers:

1) Paragon SWD Series
2) Tork A500 Series
3) Intermatic FD Series
4) Marktime Series 93

5. Drain Pan Condensate Overflow Switch: Float with integral magnet overflow switch conforming to UL508. No standby power required.

J. Outdoor Weather Station:

1. Outdoor rated ventilated plastic enclosure, off-white color, radiation shield including the following parameters.
2. Measured Parameters:

a. Temperature Sensor: Thermistor sensing element or resistance temperature device (RTD).

1) Operating Range: -40F to 140F
2) Accuracy: ± 0.54F at 68F

b. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service.

1) Measurement Range: 0-100% RH
2) Accuracy:

a) ± 3% of reading from 0%-90% RH at 50F to 86F
b) ± 5% of reading from 0%-90% RH at -4F to 50F and 86F to 140F

3. Calculated Parameters:

a. Dew Point Temperature in F
b. Wet Bulb Temperature in F
c. Enthalpy. Enthalpy sensor shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

K. Oxygen Deficiency Monitor:

1. Long-Life Zirconium Oxide Sensor: 10-year life expectancy.
2. Measurement Range: 0-25%.
3. Minimum Detection: 0.05% of oxygen.
4. Accuracy/Repeatability: ± 0.1% of range or ± 0.1% of oxygen, whichever is greater.
5. 90% full scale response times for specified range: 0-25% less than 12 seconds.
6. Backlit Digital Display: High resolution 3/4" digit LCD. Reads full scale from 00.0% to 25.0%.
7. Status LED: Indicates Power, Safe Operation, Alarm Conditions, and Loss of AC Power.

8. Alarms: Two (2) fully adjustable oxygen concentration alarms. Preset for OSHA standards. 20.0% Caution and 19.5% Danger. Dry contacts 3A. @24VDC/115VAC.
9. Danger Alarm: 95dB danger alarm preset for 19.5%.
10. Data Logger: Logs data for 15 days at 1 minute intervals, 30 days at 2 minute intervals, etc.
11. Analog Output Signal: Isolated 4-20mA.
12. Power Requirements: 115VAC, less than 10 watts.
13. Operating Temperature Range: 0F to 130F.
14. Polycarbonate enclosure suitable for use in an MRI room; mounting: wall mount.

2.12 CONDUIT AND BOXES

A. Conduit and Boxes: Refer to Electrical Section 26 05 33 for materials, sizing, and other requirements.

B. All control wiring shall be installed in conduit.

C. Conduit and Box Identification (Color and Labeling):

1. Coordinate with Government for raceway and box color requirements.
2. Refer to Electrical Section 26 05 53 for raceway and box labeling requirements.

2.13 WIRE AND CABLE

A. Wire and Cable: Refer to Electrical Section 26 05 13 for wire and cable materials.

1. Wire and Cable Color: Coordinate with Government for wire and cable color requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.

B. Install system and materials in accordance with manufacturer's instructions.

C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.

D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.

E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed ADA mounting requirements.

F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.

G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.

H. After completion of installation, test and adjust control equipment.

I. Check calibration of instruments. Recalibrate or replace.

J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.

K. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment served by emergency power shall be connected to the emergency power system. Control components shall be powered from the equipment branch (coordinate power source locations with A/E prior to beginning work). In no instance shall panel be connected to the life safety or critical branch of the emergency power system. Panels may be connected to a common 20 amp, 120 volt circuit provided the total load on the circuit does not exceed 16 amps. Circuit conductors shall be sized per the table below. All power connections to the control panels shall be performed by a licensed electrician at the cost of this Contractor. Submit circuit information (total amperage on circuit, conductors length, and panel) for control panels to the Government for approval.

Circuit Load (Amps)	Circuit Max Length	Feeder Size
≤ 5	≤ 200ft	2#12 & 1#12 ground in 3/4" conduit.
≤ 10	≤ 100ft	2#12 & 1#12 ground in 3/4" conduit.
≤ 16	≤ 75ft	2#12 & 1#12 ground in 3/4" conduit.
≤ 200	≤ 325ft	2#10 & 1#10 ground in 3/4" conduit.
≤ 100	≤ 160ft	2#10 & 1#10 ground in 3/4" conduit.
≤ 75	≤ 100ft	2#10 & 1#10 ground in 3/4" conduit.

L. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.

M. Remodeling:

1. All room devices as indicated on the drawings shall be removed by this Contractor. The Contractor shall also prepare the wall for finishes. Preparing the wall shall include patching old anchor holes (after the anchoring device has been removed) and sanding the wall to remove old paint outlines remaining from original devices. The wall shall be painted to match the existing wall prior to the installation of the new room device. If wall covering requires patching, the Contractor shall furnish new wall covering to match existing. If new wall covering is not available to match existing, the Contractor shall furnish a white acrylic or Plexiglas plate, 1/4" thick and sized to cover the void.

N. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.
2. Labels may be made with permanent marking pen in the control panels if clearly legible.

3. Use engraved labels for items outside panel such as outside air thermostats.
4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

O. VFDs:

1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.
2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.
3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.
4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.
5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

3.2 GRAPHIC DISPLAY

A. Create a customized graphic for each piece of equipment indicated on the itemized points list.

B. Components shall be arranged on graphic as installed in the field.

C. Include each graphic point listed in the itemized points list using real time data.

D. Provide a graphic representation of the following:

1. Color code the areas served by each RTU. The area shall be linked to the graphic for that area's RTU.
2. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
3. Show the location of each thermostat on the floor plan.
4. Provide separate graphics showing the heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
5. Provide a graphic showing the steam system flow diagram including control valves and steam traps as installed. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:

1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.
2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
3. Detailed graphics for each mechanical system including heat exchanger and pumps, each RTU, each exhaust fan, etc.
4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:

1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.
2. TCS Bill of Material for each system, e.g. RTU, etc.
3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

3.3 CONDUIT AND BOXES INSTALLATION

A. Conduit and Box Installation: Refer to Electrical Section 26 05 33 for execution and installation.

B. All control wiring shall be installed in conduit.

C. Conduit and Box Identification (color and labeling) installation. Refer to Electrical Section 26 05 53 for raceway and box identification installation.

D. Outlet Box Schedule: Thermostat/temperature sensor:

1. Dry Interior Locations: Provide 4" square galvanized steel with raised cover to fit flush with finished wall line. When located in concrete block walls, provide square edge title cover of sufficient depth to extend out to face of block or masonry boxes.
2. Other Conditions: Refer to Electrical Section 26 05 33 for requirements.

3.4 WIRE AND CABLE INSTALLATION

A. Wire and Cable Installation: Refer to Electrical Section 26 05 13 for execution and installation.

B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.
2. Torque test conductor connections and terminations to manufacturer's recommended values.
3. Perform continuity test on all conductors.
4. Protection of cable from foreign materials:

a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Government may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the

Contractor shall also present to the Government a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

C. Installation Schedule:

1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be made with flexible conduit rated for the environment.

3.5 FMCS INSTALLATION

A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for full ampacity of wiring or overcurrent protection of circuit controlled.

B. Naming Conventions: Coordinate all point naming conventions with Government standards. In the absence of Government standards, naming conventions shall use equipment designations shown on plans.

3.6 COMMISSIONING

A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.

C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.

D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Government's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Government's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Government's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 PREPARATION FOR BALANCING

A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).

B. Check the calibration and setpoints of all controllers.

C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.

D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified.

E. Verify the operation of all interlock systems.

3.8 TEST AND BALANCE COORDINATION

A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

B. The Contractor shall provide a minimum of eight (8) hours training for the Balancing Contractor in the use of these tools.

C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.

D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.9 DEMONSTRATION AND ACCEPTANCE

A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.10 TRAINING

A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 8 hours of training for Government's representatives. The training course shall enable the Government's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.
2. One month after completion of commissioning, the manufacturer shall provide 8 hours of training for Government's representatives. The training course shall enable the Government's representatives to perform Advanced Operations and System Management as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

3. Nine months after completion of commissioning or one month prior to the end of the warranty period, the manufacturer shall provide 8 hours of training for Government's representatives. The training course shall update the Government's representatives on Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

B. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand FMCS systems components.
4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log-on and off the system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.
10. Understand system drawings and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from FMCS controllers and ASCs.
13. Operate portable operator's terminals.

C. Advanced Operations - Training Description:

1. Make and change graphics on the workstation.
2. Create, delete, and modify alarms, including annunciation and routing of these.
3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and at user-definable time intervals.
4. Create, delete, and modify reports.
5. Add, remove, and modify system's physical points.
6. Create, modify and delete programming.
7. Add panels when required.
8. Add operator interface stations.
9. Create, delete, and modify system displays, both graphic and others.
10. Perform FMCS system field checkout procedures.
11. Perform FMCS controller unit operation and maintenance procedures.
12. Perform workstation and peripheral operation and maintenance procedures.
13. Perform FMCS system diagnostic procedures.
14. Configure hardware including PC boards, switches, communication, and I/O points.
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
16. Adjust, calibrate, and replace system components.

D. System Management - Training Description:

1. Maintain software and prepare backups.
2. Interface with job-specific, third-party operator software.
3. Add new users and understand password security procedures.

E. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

3.11 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Coordinate the exact placement of all control components with the Government Representative prior to installation.

C. Mount sensors rigidly and adequately for the environment within which the sensor operates.

D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

E. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

F. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.

G. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Government. TCC shall prime and paint the device enclosure. Color selection by Architect.

I. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

END OF SECTION 23 09 00

SECTION 23 09 13 - INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauges.

B. Thermometers.

C. Test Plugs.

D. Static and Differential Airflow Pressure Gauges.

1.2 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

C. ASTM E1 - Specification for ASTM Thermometers.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with phenolic turret style, glycerin fillable, safety case with phosphor bronze or 316 stainless steel bourdon tube, brass socket for air, steam, water or oil applications. Gauges shall be 1/2% full scale accurate per ANSI B40.1 with brushed stainless steel movement and hair spring guard. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Manufacturer:

1. Ashcroft
2. Marshalltown
3. Marsh
4. Miljoco
5. Trerice
6. U.S. Gauge Figure 1980

7. Weksler
8. Wika.

C. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.

B. Shutoff Valve: 1/2" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/2" connections, porous metal type.

D. All pressure gauge piping shall be minimum 1/2" 304 stainless steel pipe or copper tube.

2.3 THERMOMETERS

A. Alcohol/Spirit Filled Type:

1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, and locking device to allow rotation of thermometer to any angle.
2. Select thermometer for appropriate temperature range.
3. Stem: Copper plated steel, aluminum, or brass for separable socket. Stem lengths as required for application with minimum insertion of 3".
4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.
5. Manufacturer:

    a. Marsh
    b. Miljoco
    c. Trerice
    d. Weksler
    e. Wika.

B. Select scales to cover expected range of temperatures.

2.4 TEST PLUGS

A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

B. Provide extended units for all plugs installed in insulated piping.

2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70F.

C. Provide mounting brackets, probes, and shutoff valves required for proper installation.

D. The range and service shall be as required for application or as noted on the drawings.

E. Manufacturers:

1. Dwyer Magnehelic Series 2000
2. Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.
2. Coil and conceal excess capillary on remote element instruments.
3. Install gauges and thermometers in locations where they are easily read from normal operating level.
4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.
2. Provide 1/2" tubing for pressure gauge and gauge accessories.
3. Provide snubber for each pressure gauge.
4. Provide coil syphon for each pressure gauge connected to steam piping.
5. Install gauges with bottom threaded connections at 6 o'clock position.

C. Thermometers:

1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.
3. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

END OF SECTION 23 09 13

SECTION 23 21 00 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings

B. Valves

C. Check Valves

D. Strainers

E. System Piping Schedule

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.3 REFERENCES

A. ANSI/AWS D1.1 - Structural Welding Code.

B. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

C. ASME - Boiler and Pressure Vessel Code.

D. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

E. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

F. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

G. ASME B16.5 - Pipe Flanges and Flanged Fittings.

H. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

I. ASME B16.12 - Cast Iron Threaded Drainage Fittings.

J. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings

K. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.

L. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

M. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).

N. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

O. ASME B16.51 - Copper And Copper Alloy Press-Connect Pressure Fittings.

P. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.

Q. ASME B18.2.2 - Square and Hex Nuts, Inch Series.

R. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

S. ASME B31.9 - Building Services Piping.

T. ASME Section 9 - Welding and Brazing Qualifications.

U. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.

V. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

W. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

X. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

Y. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

Z. ASTM A536 - Standard Specification for Ductile Iron Castings

AA. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.

BB. ASTM B32 - Standard Specification for Solder Metal.

CC. ASTM B88 - Seamless Copper Water Tube.

DD. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.

EE. ASTM E413-87 - Classification for Rating Sound Insulation

FF. ASTM F3226 - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

B. Grooved joint couplings and fittings shall be referred to on drawings and product submittals, and be identified by the manufacturer's listed model or series designation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 STEEL PIPE (ABOVE GRADE)

A. Design Pressure 125 psig, Maximum Design Temperature 225F (230F for grooved couplings).

B. Black Steel; Standard Weight; Welded or Flanged Joints:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
2. Joints: Butt-welded or flanged.
3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.

C. Galvanized Steel; Schedule 40; Threaded Joints:

1. Galvanized Steel Pipe: ASTM A53, Schedule 40 galvanized.
2. Fittings: Galvanized cast iron screwed drainage type, ASME B16.12.
3. Joints: Screwed.
4. Service: Not allowed on boiler drains and overflow.

2.2 COPPER PIPE (ABOVE GRADE)

A. Design Pressure 125 psig. Maximum Design Temperature 225F.

B. Copper Pipe; Type L; Soldered Joints:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Copper; DWV; Soldered:

1. Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.
2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
3. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

2.3 VALVES

A. Shutoff Valves:

1. Ball Valves:

a. BA-1 (Steel and Copper): 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.

1) Body: Bronze of a copper alloy containing less than 15% zinc.

a) Manufacturers: Apollo #77C-140, Milwaukee #BA-400, Watts, Nibco #585-70-66.

2) Body: Dezincification resistant brass alloy. Jomar T/S-100CSSG.

3) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping. (For example, Jomar modifies valve part number with -IH for insulated handle.)

4) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120F, heating water piping over 120F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim. (For example, Jomar modifies valve part number with -LH for locking handle.)

2. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20F to 225F continuous and 250F intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze, stainless steel, or electroless-nickel coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size.

2) Manufacturers:

a) Victaulic #300
b) Center Line Series 200
c) Keystone #222
d) Watts #DBF-03-121-1P
e) Nibco N200 Series or LD2000 Series
f) Milwaukee CL Series

2.4 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120F and as indicated on the drawings.

2.5 CHECK VALVES

A. CK-4: Check Valves (Copper Pipe); 2" and under, 200 psi WOG at 150F, solder, bronze, horizontal swing.

1. Manufacturers:

a. Crane #1342
b. Hammond #IB912
c. Walworth #406SJ
d. Milwaukee #1509
e. Watts #B-5001
f. NIBCO #S-413.

B. CK-13: Check Valves (Steel Pipe); 2-1/2" thru 12", 200# WOG, double disc wafer type, non-slam silent check, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size.

1. Manufacturers:

a. Milliken 740G
b. NIBCO W-920-W
c. Crane Duo-Chek
d. Victaulic V715

C. CK-14: Center Guided/Axial Sliding Disk Silent Check Valve: 2" thru 24", ductile iron body with stainless steel spring, suitable for vertical installation. Stainless steel disc(s) with elastomer seat/seal, or elastomer coated ductile iron disc with welded-in nickel seat.

1. Manufacturers:

a. Flow Tech
b. Titan Flow Control
c. Champion
d. Av-tek

2.6 STRAINERS

A. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S at 353F, 200 psi WOG at 150F.

1. Manufacturers:

a. Armstrong #F4SC
b. Metraflex #TS
c. Mueller Steam Specialty Co. #351
d. Sarco #BT
e. Watts #777
f. NIBCO T-221-A.

B. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S at 353F, 175 psi WOG at 150F.

1. Manufacturers:

a. Armstrong #A1FL
b. Metraflex #TF
c. Mueller Steam Specialty Co.#758
d. Sarco #CI-125
e. Watts #77F-D
f. Victaulic #732 or #W732
g. NIBCO F-721-A.

C. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

1. Pipe Size:

a. 1/4" - 2": 1/32" screen
b. 2-1/2" - 8": 1/16" screen
c. 10" and Up: 1/8" screen

D. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

E. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain-end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

D. Connect to all equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

E. Flush and clean piping as defined below. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).

F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 SYSTEMS, PIPING, AND VALVE SCHEDULE

A. Heating Water (Above Grade - maximum 200F unless noted otherwise below):

1. Copper Pipe; Type L; Soldered Joints: 2" and Under
2. Black Steel; Standard Weight: Welded or Flanged Joints: 2-1/2" and Over
3. Shutoff Valves: BA-1, BF-1
4. Check Valves: CK-4, CK-13, CK-14
5. Strainers: ST-1, ST-2

B. Equipment Drains and Overflows:

1. Galvanized Steel; Schedule 40; Threaded Joints: All Sizes
2. Copper; DWV; Soldered: 4" and Under

3.3 TESTING PIPING

A. Test pipes underground or in chases and walls before piping is concealed.

B. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.

C. Test the pipe with water at 1.5 times the design pressure but not less than 125 psig pressure. Hold pressure for at least two hours.

D. Test to be witnessed by the Government's representative, if requested.

3.4 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Government. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Government prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
3. Drain the system after circulating the chemical cleaner for six hours at 150F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.
4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 23 25 00. The system shall not be allowed to sit empty for any length of time.
5. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
6. Water samples may be taken by the Government to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.
7. Chemical cleaning applies to the following systems:

    a. Heating Water

3.5 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
6. Install bell and spigot pipe with bells upstream.
7. Seal pipes passing through masonry or precast walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
2. Provide clearance for installation of insulation, and access to valves and fittings.
3. Prepare pipe, fittings, supports, and accessories for finish painting.
4. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
5. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
6. Provide flanges or unions at all final connections to equipment, traps and valves.
7. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
8. Horizontal swing check valves may only be installed in horizontal position. Do not install horizontal swing check valves in upward or downward flow direction. Where upward or downward flow installation is required, use spring-assisted, non-slam check valve.

3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. 2-1/2" and larger fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.

H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.7 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.

B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.

C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.

D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.

E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.

F. All vent and drain piping shall be of same materials and construction as the service involved.

3.8 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

3.9 JOINING OF PIPE

A. Threaded Joints (Steel Pipe):

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints (Steel Pipe):

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:

    a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
    b. Maximum pressure rating of at least 250 psig.
    c. Minimum temperature rating: -10F.
    d. Maximum temperature rating of at least 170F for water and glycol solution systems operating 140F and less.
    e. Maximum temperature rating of at least 250F for water and glycol solution systems operating above 140F and up to 180F.

C. Solder Joints (Copper Pipe):

1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type conforming to ASTM B813.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470F.

D. Welded Joints (Steel Pipe):

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish certificates qualifying each welder to the Government's Representative prior to start of work.
3. The Government's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.

4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.

END OF SECTION 23 21 00

SECTION 23 21 16 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Air Vents

B. Automatic Air Vents

C. Makeup Water Accessories

D. Safety Relief Valves

E. Triple Duty Valves

F. Suction Diffusers

G. Balancing Valves

H. Combination Piping Packages

I. Expansion Tank

J. Air Separators

K. Drain Valves and Blowdown Valves

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Code.

B. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

C. ASME B31.9 - Building Services Piping.

D. ASME Section 9 - Welding and Brazing Qualifications.

E. ASTM A536 - Standard Specification for Ductile Iron Castings

F. ASTM B32 - Standard Specification for Solder Metal.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 MANUAL AIR VENTS

A. At end of main and other points where large volume of air may be trapped, use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

B. On branch lines and small heating units, use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.2 AUTOMATIC AIR VENTS

A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240F and 125 psi, 1/2" or 3/4" inlet, 3/8" minimum threaded outlet.

1. Manufacturers:

a. B&G #87
b. Armstrong
c. Spirotherm
d. Taco 419
e. Watts

B. High capacity automatic air vent (for air separator or high point pipe connection). Brass or cast-iron construction. Maximum 240F and 125 psi operating pressure and minimum of 115 psi system venting pressure, 3/4" inlet, 3/8" minimum threaded outlet.

1. Manufacturers:

a. B&G #107
b. Armstrong AV
c. Spirotherm
d. Taco 409
e. Watts

2.3 MAKEUP WATER ACCESSORIES

A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.
2. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225F maximum temperature.
3. Manufacturers:

a. Armstrong
b. Bell & Gossett
c. Conbraco
d. Thrush
e. Watts

B. Relief Valve:

1. For water fill lines to hydronic systems.
2. Cast iron or bronze body, 1/2" or 3/4" screwed connections, 125 psig working pressure, 225F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.
3. Manufacturers:

a. Armstrong
b. Bell & Gossett
c. Conbraco
d. Taco
e. Watts

C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.
2. Provide an air gap fitting and piping to drain.
3. If not indicated on the drawings, unit shall be same size as pipe.
4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

2.4 SAFETY RELIEF VALVES

A. Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250F. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled.

B. Manufacturers:

1. Kunkle # 537
2. B&G
3. Conbraco
4. McDonnell & Miller
5. Watts

2.5 TRIPLE DUTY VALVE

A. Type TD-1: 2" and above, 175 psi working pressure, flanged, cast iron, non-slam check valve, calibrated throttling, shutoff capabilities, angle or straight pattern. Pressure drop with design flow at 100% open shall not exceed 10 feet. Size to match pipe (not pump outlet) size, but reduce size by not more than one (1) if needed to provide at least 3 feet of differential pressure across the flow measuring taps at scheduled flow rate.

B. Manufacturers:

1. Armstrong
2. Bell & Gossett
3. Taco
4. Wheatley
5. Victaulic

2.6 Triple duty valves may replace the combination of shutoff valve, balancing valve, and check valve on constant volume systems. Triple duty valves are not permitted on variable volume systems.SUCTION DIFFUSER

A. Furnish and install on base-mounted pumps with inlet size same as pipe size shown on the drawing.

B. In no case shall pressure drop exceed 3.0 psi.

C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" maximum diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to blowdown connection. Provide minimum 16 mesh bronze or stainless steel startup strainer. The startup strainer shall be removed after the system has been started, cleaned (refer to Hydronic Piping for additional information), and is operating under normal conditions, but before the system is turned over to the Government. Hang the startup strainer on the piping near the pump after it is removed.

D. Manufacturers:

1. Amtrol
2. Armstrong
3. Bell & Gossett
4. Keckley
5. Patterson
6. Taco
7. Wheatley
8. Victaulic

2.7 BALANCING VALVE

A. Rated for 125 psi working pressure and 250F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units that sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Valves in copper piping shall be brass or bronze.

1. Quarter-Turn Ball Valve Style (Brass or Bronze):

a. Manufacturers:

1) Bell & Gossett "Circuit Setter Plus"

2. Quarter-Turn Venturi Style (Brass or Bronze):

a. Manufacturers:

1) Presso "B+"
2) Griswold "Quickset"
3) Gerand "BALVALVE Venturi"
4) HCI "Terminator B"
5) Nexus Valve "UltraXB Orturi"
6) IMI Hydronic Engineering "Accusetter"

3. Multi-Turn Style (Brass or Bronze):

a. Manufacturers:

1) Tour&Anderson (STAD)
2) Armstrong "CBV"
3) Victaulic 786
4) Macon STVL/STV
5) MEPCO MBV
6) Wheatly GS

7) NIBCO 1710
8) RWV 951

D. Balancing valves in ferrous piping over 2 size shall have flanged or grooved ends and steel or cast iron construction. Option to balancing valves noted above are flow sensor specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style (Ferrous Piping greater than 2"):

a. Manufacturers:

1) B&G "Circuit Setter"

2. Quarter-Turn Venturi Style (Ferrous Piping greater than 2"):

a. Manufacturers:

1) Presso "B+"
2) Taco "Accu-flo"
3) HCI "Terminator G"
4) Nexus Valve "Nextrol NXFB"
5) IMI Hydronic Engineering "Accusetter"

3. Multi-Turn Style (Ferrous Piping greater than 2"):

a. Manufacturers:

1) Armstrong "CVB-II"
2) Tour&Anderson (STAF, STAG)
3) Victaulic 788/789
4) Macon STVA
5) MEPCO MBV
6) NIBCO 737
7) RWV 951

E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.8 COMBINATION PIPING PACKAGES

A. Combination piping packages are allowed at unitary equipment only 1” pipe size and smaller in lieu of individual components specified for hydronic coils and devices containing hydronic coils. Configuration of combination pieces shall match layouts on the drawings. Each component of the combination piping packages shall meet these specifications for the individual components being combined. Coil connections shall be rigid or made with flexible hose equal to Metraflex SFLXTU18. Combination piping packages shall include:

1. Shutoff valves
2. Wye strainers, with minimum 1/4" turn strainer blowdown valves with hose thread and cap.
3. Manual balancing valves with memory stop. Automatic flow control devices are not allowed.
4. Test plugs

5. Manual air vents
6. Unions

B. Manufacturers:

1. FDI Flowset
2. Griswold
3. Hays Fluid Controls
4. HCI Terminator
5. Nexus Coil Pak
6. Victaulic

2.9 EXPANSION TANK

A. Bladder Type:

1. Tank shall be welded steel, ASME construction and stamped.
2. Tank shall be complete with heavy-duty replaceable butyl bladder, charging valve, lifting ring, drain tapping, and system connection.
3. 125 psig working pressure and 240F maximum operating temperature.
4. Manufacturers:

a. Thrush
b. Taco
c. Bell & Gossett
d. Armstrong
e. Watts
f. Wessels
g. Wheatley
h. Amtrol
i. Patterson
j. Grundfos

2.10 TANGENTIAL AIR SEPARATORS

A. Separators shall be ASME constructed and stamped for 125 psi working pressure and 350F operating temperature.

B. Provide openings for inlet, outlet, blowdown, and expansion tank.

C. Separators shall be line size or larger, with maximum pressure drop of 1 psi. Refer to drawing for separator sizing.

D. Separators shall not include strainers, unless noted on the drawings. When furnished, strainers shall be removable and the blowdown fittings shall have drain valves.

E. Manufacturers:

1. Amtrol
2. Armstrong

3. Bell & Gossett
4. Taco
5. Wheatley
6. Patterson
7. Wessels
8. Grundfos

2.11 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

2.12 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron and steel connected to each other.
2. Brass, copper, and bronze connected to each other.
3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225F.
2. Manufacturers:

a. Elster Group ClearFlow fittings
b. Victaulic Series 647
c. Grinnell Series 407
d. Matco-Norca

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
6. Manufacturers:

    a. EPCO
    b. Central Plastics
    c. Pipeline Seal and Insulator
    d. F.H. Maloney
    e. Calpico

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves/Fittings and Accessories:

1. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.
2. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.

3. Prepare accessories for finish painting.
4. Install accessories with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
5. Provide flanges or unions at all final connections to equipment, traps and valves.
6. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

END OF SECTION 23 21 16

SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All pumps except where integral with a manufactured piece of equipment.

B. Pump controls where self-contained.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Submit motor data indicating compliance with Section 23 05 13.

PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 RPM unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Heating pumps shall be suitable for 225F water.

F. Motors shall comply with Section 23 05 13 including, but not limited to:

1. Single phase motors less than 1 HP shall be electronically commutated or shall have a minimum motor efficiency of 70%.
2. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service.
3. All 480 volt motors driven by VFDs shall be provided with shaft grounding rings or grounding brushes or ceramic bearings as a means to protect bearings from adverse shaft currents.

G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

H. Pumps specified in this section operating in clean water with a flow greater than 25 GPM and less than 459 feet head shall have a maximum Pump Energy Index (PEI) as scheduled on the drawings. In no case shall the PEI exceed 1.0.

2.2 BASE MOUNTED END SUCTION PUMPS

A. Type: Centrifugal, single stage.

B. Casing: Cast iron, single suction, rated for greater of 150 psi or 1.25 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.

E. Bearings: Grease lubricated roller or ball bearings with grease fittings. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.

F. Drive: Flexible coupling with OSHA-approved guard.

G. Seals: Mechanical type with internal flushing rated for -20F to 225F with Buna elastomer, carbon primary ring, and ceramic stationary ring.

H. Baseplate: Heat treated cast iron or reinforced heavy steel.

I. Manufacturers:

1. Bell & Gossett
2. Taco
3. Aurora
4. Armstrong
5. Grundfos/Peerless/PACO

2.3 IN-LINE PUMP

A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.

B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.

D. Shaft: Steel or stainless steel.

E. Seals: Mechanical type with internal flushing rated for -20F to 225F and comprised of Buna elastomer, carbon primary ring, and ceramic stationary ring.

F. Seals: Mechanical type rated for -20F to 250F with EPR or EPT bellows and seat gasket, carbon primary ring, and silicon-carbide stationary ring.

G. Manufacturers:

1. Bell & Gossett
2. Taco
3. Aurora
4. Armstrong
5. Grundfos/Peerless/PACO

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.
2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18" clearance for removal of suction diffuser.
3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
4. Where electronically commutated motors are equipped with manual speed adjustment, pump speed shall be adjusted during the testing, adjusting, and balancing phase to achieve scheduled performance.

B. In-Line Pumps:

1. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
2. Pump orientation shall be in accordance with the manufacturer's recommendations.

C. Base-Mounted Pumps:

1. Base-mounted pump alignment shall be inspected and approved by a factory-trained representative. If alignment is not satisfactory, the representative shall field laser align the shaft. If the pump is aligned in the field, an alignment report shall be provided as part of the closeout documents.
2. Base-mounted pump shall be aligned in accordance with the pump manufacturer’s recommendations. A factory-trained representative shall laser align the pump to meet the manufacturer’s requirements and tolerances. An alignment report shall be provided as part of the project closeout documents.
3. Unless otherwise shown on the drawings, mount all base mounted pumps on 4" high concrete pads and anchor frames to pads with cast-in-place anchors.
4. All base-mounted pumps shall be grouted-in. Follow manufacturer's instructions for grouting.

END OF SECTION 23 21 23

SECTION 23 22 00 - STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Valves.

C. Steam Piping System.

D. Condensate Piping System.

E. Acoustical Lagging.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9.

1.3 REFERENCES

A. ANSI/ASME SEC 9 - Welding and Brazing Qualifications.

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

C. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

D. ANSI/ASME B16.9 - Factory Made Wrought Steel Butt Welding Fittings.

E. ANSI/ASME B31.1 - Code for Power Piping.

F. ANSI/ASME B31.9 - Building Services Piping.

G. ANSI/AWS D1.1 - Structural Welding Code.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

I. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

J. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

K. ASTM E413-87 - Classification for Rating Sound Insulation.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe fittings, valves and accessories.

B. Include certification of compliance with ANSI/AWS D1.1 for all welders.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent corrosion and entrance of foreign matter.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9 for the following pipe systems:

1. Non-boiler external pipe systems that operate up to 150 psi.

B. Conform to ANSI/ASME B31.1 for boiler external pipe systems that operate above 15 psi.

C. Refer to ANSI/ASME B31.1 and ANSI/ASME B31.9 for "boiler external piping" and "non-boiler external piping" definitions.

1.7 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required steam and steam condensate piping systems electronic CAD drawings to be provided to the Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 STEEL PIPING (0 TO 125 PSIG)

A. Steel Pipe; 0 to 125psig; Standard Weight; Threaded Joints:

1. Design Pressure: 125 psig. Maximum Design Temperature: 353F.
2. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.
3. Joints: Screwed.
4. Fittings: 125 psi S to 175 psi. WOG, cast iron, ASTM A126, ANSI B16.4.
5. Unions: 250 psi S to 500 psi. WOG, black malleable iron, ground joint with brass seat.

B. Steel Pipe; 0 to 125psig; Standard Weight; Flanged Joints or Welded Joints:

1. Design Pressure: 125 psig. Maximum Design Temperature: 353F.
2. Pipe: Standard weight black steel, beveled ends, ASTM A53.
3. Joints: Butt welded or flanged.
4. Fittings: Standard weight seamless steel, butt welded type, ASTM A234, Grade WPB, ANSI B16.9.
5. Flanges: 150 lb. forged steel, welding neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Flange face seal weld (backweld) is required for slip-on flanges.

C. Steel Pipe; 0 to 125psig; Extra Strong; Threaded Joints:

1. Design Pressure: 125 psig. Maximum Design Temperature: 353F.
2. Pipe: Extra strong black steel, threaded and coupled, ASTM A53.
3. Joints: Screwed.
4. Fittings: 125 psi S to 175 psi WOG, cast iron, ASTM A126, ANSI B16.4.
5. Unions: 250 psi S to 500 psi WOG, black malleable iron, ground joint with brass seat.

D. Steel Pipe; 0 to 125psig; Extra Strong; Flanged Joints or Welded Joints:

1. Design Pressure: 125 psig. Maximum Design Temperature: 353F.
2. Pipe: Extra strong black steel, beveled ends, ASTM A53.
3. Joints: Butt welded or flanged.
4. Fittings: Extra strong seamless steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.
5. Flanges: 150 lb. forged steel, welding neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Welding neck type shall be used wherever possible and shall have bore to match pipe. Flange face seal weld (backweld) is required for slip-on flanges.

2.2 VALVES

A. Shutoff Valves:

1. Gate Valves:

a. GA-1 (0 to 125 psig): 2" and under, 125 psi S at 353F, 300 psi WOG at 150F, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131, Jomar T-351G.
b. GA-2 (0 to 125 psig): 2-1/2" thru 12", 125 psi S at 353F, 200 psi WOG at 150F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, NIBCO F-617-O.

B. Shutoff Valves:

1. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed ends, bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.

a. Body: Bronze

1) Manufacturers: Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB, Jomar T/S-200CSS.

b. Body: Dezincification resistant brass alloy, lead free. Jomar T/S-100SSS.

2. BA-1A (0 to 125 psig): 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

C. Throttling/Shutoff Valves:

1. Globe Valves (0 to 125 psig):

a. GL-1 (0 to 125 psig): 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413, Watts #B-4010-T, NIBCO T-235-Y.
b. GL-2 (0 to 125 psig): 2-1/2" thru 10", 125 psi S at 353F, 200 psi WOG at 150F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, NIBCO F-718-B.

2.3 CHECK VALVES

A. CK-1 (0 to 125 psig): 2" and under, 125 psi S at 353F, 200 psi WOG at 150F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #3406, Milwaukee #509, NIBCO T-413-Y, Jomar T-511G.

B. CK-6 (0 to 125 psig): 2-1/2" thru 12", 125 psi S at 353F, 200 psi WOG at 150F, flanged, all iron, horizontal swing. Crane #373-1/2, Hammond #IR1126, Stockham #G933, Walworth #8928-1/2F, Milwaukee #F2971, Watts #F-511-R, NIBCO F-918-Ng.

2.4 STRAINERS

A. ST-1 (0 to 125 psig): Cast iron body, screwed ends, screwed cover, 250# steam at 406F, 400# WOG at 150F. Armstrong #CA1SC, Metraflex #TS, Mueller Steam Specialty Co. #11M, Sarco #IT, Watts #77S, NIBCO T-751. Bronze body strainer 125# may be used as contractor option.

B. ST-2 (0 to 125 psig): Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi Sat 353F, 175 psi WOG at 150F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F, NIBCO F-721.

C. Unless otherwise indicated, strainers shall have stainless steel screens with perforations as follows:

1. Steam All Sizes: 1/32"
2. Condensate All Sizes: 3/64"

D. Furnish pipe nipple with gate valve and threaded cap to blow down all strainer screens.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories.

D. Make connections to equipment with flanges or unions.

E. After completion, fill, clean, and treat systems.

3.2 PIPING SCHEDULE

A. Steam (0 to 125 psig):

1. Steel Pipe; 0 to 125 psig; Standard Weight; Threaded Joints: 2" and Under
2. Steel Pipe; 0 to 125 psig; Standard Weight; Flanged Joints or Welded Joints: 2-1/2" and Over
3. Shutoff Valves: GA-1, GA-2, BA-1, BA-1A
4. Throttling: GL-1, GL-2
5. Check Valves: CK-1, CK-6
6. Strainers: ST-1, ST-2

B. Condensate Piping (0 to 125 psig):

1. Steel Pipe; 0 to 125 psig; Extra Strong; Threaded Joints: 2" and Under
2. Steel Pipe; 0 to 125 psig; Extra Strong; Flanged Joints or Welded Joints: 2-1/2" and Over
3. Shutoff Valves: BA-1, BA-1A
4. Check Valves: CK-1, CK-6
5. Strainers: ST-1, ST-2

3.3 TESTING PIPING

A. Complete all testing of pipes underground, or in chases and walls, before piping is concealed.

B. Complete all testing before insulation is applied, or if insulation is applied before the pipe is tested and a leak develops which ruins the insulation, the pipe installing contractor shall arrange and pay for replacing the damaged insulation.

C. Test piping with water at 150% of the maximum operating pressure.

D. Hold pressure for at least two hours.

E. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

3.4 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, all loose dirt, scale, oil and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice subject to the approval of the Architect/Engineer's representative. Chips and burrs from machinery or thread cutting operation shall be blown out of pipe before assembly. Cutting oil shall be wiped from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external pipe joints by peening, chipping and wire brushing.
3. Notify the Government's representative prior to starting any post erection cleaning operation in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Government's representative regarding specific procedures and scheduling. Arrange for proper disposal of cleaning and flushing fluids.
4. When system clean, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
5. When the system is started up for the first time, discharge the condensate to drain per the boiler manufacturer's recommendations or for 24 hours, whichever is more restrictive. Add domestic cold water to the drain at a sufficient rate to reduce the condensate temperature to a maximum of 140F.

3.5 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
2. Install piping to conserve building space and not interfere with use of space, other work, or equipment.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. Slope steam piping 0.25" in 10 feet in direction of flow. Use eccentric reducers to maintain bottom of pipe level.
5. Slope steam condensate piping 0.5" in 10 feet.
6. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply zinc rich primer to welds.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Provide clearance for installation of insulation and access to valves and fittings.
2. Provide access doors where valves and fittings are not exposed.
3. Provide drip trap assembly at low points and before control valves and pressure reducing valves.
4. Provide loop vents over trapped sections.
5. Prepare pipe, fittings, supports, and accessories for finish painting.

6. Provide drip legs as shown on the drawings, at low points, traps, and the base of all risers in steam, and condensate pipes. Unless otherwise shown, drip legs shall be full pipe size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, with a reducer and a 3/4"shutoff valve.
7. Install valves with stems upright or horizontal, not inverted.
8. Provide shutoff valves in supply and return to all equipment.
9. Install strainers in steam piping with the "wye" of the strainer to the side of the pipe in the horizontal plane to avoid pooling of condensate.

3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied identification sufficient to determine conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of system. Use plugs, caps, blind flanges or other items designed for this purpose.

E. Run pipe straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and to provide needed flexibility in piping.

F. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be long radius type, unless otherwise noted.

G. Provide flanges or unions at all connections to equipment traps and valves to facilitate dismantling.

H. Arrange piping and connections so equipment served may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

I. Use full and double lengths of pipe wherever possible.

J. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size made only at control valve, pump, or trap.

K. Cut all pipe to exact measurement and install without springing or forcing.

L. Avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or building elements with piping connections or supports.

M. Unless otherwise indicated, branch takeoffs shall be from top of mains or headers at either a 45-degree or 90-degree angle from the horizontal plane for steam pipes.

N. Branch takeoffs shall be from the top, side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping for liquids.

3.7 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise indicated.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. Branch connections from mains may be cut into black steel pipe using forged weld-on fittings:

1. Steam.
2. Condensate.

D. Use of forged weld-on fittings is further limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch pipe is at least two sizes under main size.

3.8 JOINING OF PIPE

A. Threaded Joints (Steel Pipe):

1. Screw threads shall conform to ANSI B2.1 "Pipe Threads".
2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
3. Protect plated pipe and valve bodies from wrench marks.
4. Apply high temperature, anti-seize thread lubricant to male threads.

B. Flanged Joints (Steel Pipe):

1. Steel flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting for services up to 399F shall be ASTM A307, Grade B bolts and heavy hexagonal nuts. Bolting for services from 400F to 790F shall be ASTM A193, Grade B-7 with Grade 24 hexagonal nuts. Bolts and nuts shall conform to ANSI B18.2.1 "Square and Hex Bolts" or B18.2.2 "Square and Hex Nuts".
3. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts so those directly opposite are torqued in sequence.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

    a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
    b. Gaskets used in piping systems for saturated steam service shall be approved by manufacturer for use in saturated steam applications up to and including 150 psig.

c. Gaskets used for superheated steam applications and for saturated steam systems with operating pressures greater than 150 psig saturated steam shall be of the spiral wound "chevron" metallic type with flexible graphite filler by the following manufacturers:

1) Flexitallic (LS Style CG)
2) TEADIT (Style 913)
3) Garlock (Flexseal Style RW)
4) Lamons (SpiraSeal Style WR)
5) Leader (Style LG-13)

d. Gaskets used for steam condensate service including, but not limited to, condensate return, boiler feedwater, and condensate transfer piping systems shall meet the following requirements:

1) Maximum pressure rating of at least 2000 psig.
2) Maximum continuous temperature rating of at least 650F.

C. Welded Joints (Steel Pipe):

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish to the Government's Representative prior to start of work certificates qualifying each welder.
3. The Government's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.

END OF SECTION 23 22 00

SECTION 23 22 18 - STEAM AND STEAM CONDENSATE SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steam Traps

B. Flash Tanks

C. Condensate Return Units

D. Pressure Reducing Valves

E. Pressure Reducing Valves Noise Suppression

F. Safety Valves

G. Vacuum Breakers

1.2 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

B. Traps: Remanufactured traps are not acceptable.

1.3 REFERENCES

A. ANSI/ASTM - Boilers and Pressure Vessels Code.

B. ANSI/NFPA 70 - National Electrical Code.

C. AHRI 460 - Standard for Commercial and Industrial Humidifiers.

D. ASTM A105 - Forgings, Carbon Steel, for Piping Components.

E. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

B. Submit schedule indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.

C. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

D. Submit manufacturer's installation instructions.

E. Submit operation and maintenance data.

PART 2 - PRODUCTS

2.1 STEAM TRAPS

A. Furnish traps as scheduled on the drawings.

B. Inverted bucket type with thermic vent, 250 psig rated, cast iron body, side inlet and outlet, and all internal components constructed of stainless steel and renewable in-line.

1. Manufacturers (0-250 psig):

a. Armstrong Machine Works Series 800T
b. Spirax/Sarco Co., Inc. Type B
c. Hoffman Industrial Specialties Co. Series 600 T

2.2 LOW PRESSURE CONDENSATE RETURN UNITS (200F, Atmospheric vented, Floor mounted tank)

A. Units: Consist of factory assembled packaged receiver, pumps, float switches, controls and accessories for duplex operation.

B. Receiver: Cast iron with inlets, vent, and drain connections.

C. Pumps: Submergible type, rated to 200F condensate with 2 ft NPSHR, bronze impeller, stainless steel shaft, renewable case rings, close coupled to motor, RPM as specified on the drawings.

D. Controls: Mechanical alternator shall be two pole; float switch shall start and stop pump. Provide control transformer for alternator if required for three-phase power.

E. Control Cabinet: Single point electrical connection, NEMA 1 or 2 enclosure, UL listed components, with hinged door, combination fused disconnect magnetic starters with overload relays, terminal strip, fusible control circuit transformer, and mechanical alternator. 'Hand-Off-Auto' switch, selector 'lead-off-lag' switches, test buttons, high level alarm light, dry contacts for high level alarm, acknowledge button and alarm horn.

F. Control Sequence: Each pump control circuit shall be completely independent of the other. Operate pumps on high level, alternating after each cycle. Operate second pump upon failure of first pump and alarm.

G. Accessories: Pressure gauge on each pump discharge, externally adjustable double pole float switches. Dial thermometer, drain valve.

H. Capacity as scheduled on the drawings.

I. Manufacturers:

1. Roth Pump
2. Domestic Pump

2.3 PRESSURE REDUCING VALVE

A. Capacity as scheduled on drawings.

B. Externally pilot operated, spring loaded adjustable pilot operator, single guided equal percentage plug type valve, with cast iron body and bonnet, normally closed diaphragm operator, stainless steel cage and seat for a maximum of 150 psig.

1. Manufacturers:

a. Hoffman

b. Spirax/Sarco
c. Spence

2.4 PRESSURE REDUCING VALVES NOISE SUPPRESSION

A. Insulation Jacket: Provide high density, Teflon impregnated fiberglass mass loaded vinyl insulation jacket for pressure reducing valve and noise suppressor. Same manufacturer as pressure reducing valve.

B. Noise Suppressor: Dissipative reactive noise suppressor. Welded steel pressure shell and flanges with drain connection. Stainless steel acoustic material. Suppressor shall not induce back pressure. Flanged connections. Expanded outlet flange for attachment to downstream piping. Suppressor shall provide a minimum of 10 dBA reduction. Same manufacturer as pressure reducing valve.

C. Muffling Orifice Plate: Stainless steel plate with drilled orifices welded to stainless steel inlet screen. Orifice shall be installed between flanges downstream of regulator. Design to provide minimum of 6 dBA reduction. Same manufacturer as pressure reducing valve.

2.5 SAFETY VALVES

A. SV-2: (Steam Service) Spring loaded disc type with bronze, cast iron, or steel body (steel body is required above 250 psig or 406F, lifting lever, stainless steel disc and nozzle, and side outlet. Capacities ASME certified and labeled for Section I for boilers over 15 psig, Section IV for boilers up to 15 psig, and Section VIII for unfired pressure vessels or downstream of pressure reducing valves. Provide bellows trim where needed to compensate for piping backpressure. Include drip pan elbow with pan with NPT or flanged connection to safety valve.

1. Manufacturers:

a. Consolidated Series 1900 or 1900/P
b. Kunkle - Fig. 6030, 6252, 300, or 600
c. Keckley - Type 40 or 301

2.6 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in steam, condensate, boiler feed water piping, and as indicated on the drawings.

2.7 VACUUM BREAKER

A. Spring loaded type selected or adjusted for the minimum possible opening pressure, but never over 11" water gauge.

B. Rated for 150 psig and 366F.

C. Manufacturers:

1. Johnson VB8
2. Sarco VB14
3. Hoffman 62
4. B&G 26

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. General Installation Requirements:

1. Install specialties in accordance with manufacturer's instructions.
2. Size traps to handle minimum of two and one-half times maximum condensate load of apparatus served, unless noted otherwise.
3. All traps shall be minimum 3/4" size.
4. Install traps with unions or flanges at both ends.
5. Provide shutoff valve and strainer at inlet, and check valve and shutoff valve at discharge of traps.
6. Provide minimum 18" long dirt pocket of same size as apparatus return connection between apparatus and trap, unless noted otherwise on drawings.
7. Remove thermostatic elements from traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.

B. Insulate steam and steam condensate specialties in accordance with Section 23 07 16 - HVAC Equipment Insulation and Section 23 07 19 - HVAC Piping Insulation.

C. Condensate Return Unit:
1. Install full-sized P-traps in the overflow drain piping from condensate return units and extend piping to nearest floor drain.

D. Pressure Reducing Valves:

1. Provide pressure reducing valve stations with pressure reducing valve, valved bypass, strainer and pressure gauge on upstream side; safety valve and pressure gauge on downstream side.

2. The size of the bypass valve at pressure reducing stations shall be one size smaller than the pressure reducing valve unless noted otherwise. Provide eccentric reducers as required. The wide-open capacity of the bypass valves shall not exceed the capacity of the relief valve.

E. Safety Valve:

1. Rate safety valves for maximum capacity of largest available trim for pressure reducing valve(s) or maximum capacity of bypass valve(s), whichever is larger, at maximum possible pressure upstream of pressure reducing valve. Set at maximum 20 percent above reduced pressure.
2. Terminate safety valves outdoors. Provide drip pan elbow with drain connection to nearest floor drain.

END OF SECTION 23 22 18

SECTION 23 25 00 - CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Treatment for Closed Water Systems

B. Chemical Feed Equipment.

1.2 REFERENCES

A. ASTM D 859-00: Test Method for Silica in Water

B. ASTM D 1066-97: Practice for Sampling Steam

C. ASTM D 1067-92: Test Methods for Acidity or Alkalinity in Water

D. ASTM D 1068-03: Test Methods for Iron in Water

E. ASTM D 1126-02: Test Method for Hardness in Water

F. ASTM D 1129-03a: Terminology Relating to Water

G. ASTM D 3370-95a: Practices for Sampling Water from Closed Conduits

H. AWWA C700-02: Cold-Water Meters - Displacement Type

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Include system schematics, equipment locations, and controls schematics.

C. Submit product data indicating chemicals and equipment.

D. Submit manufacturer's installation instructions.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

F. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports indicating analysis of system water after cleaning and after treatment.

1.4 EXTRA STOCK

A. Provide clean cartridges or bags in all bypass (pot) feeders with filters.

B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters installed. Deliver to Owner at job site.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include data on pumps and other equipment including spare parts lists, procedures, and treatment programs.

C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.

D. Include list of treatment chemicals and associated SDS.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall have local representatives with water analysis laboratories and full-time service personnel.

1.7 REGULATORY REQUIREMENTS

A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Provide only chemicals approved for use and disposal by local authorities. Contact the Government if any specified chemicals are prohibited.

1.8 MAINTENANCE SERVICE

A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems for one year from Date of Substantial Completion:

1. Provide technical service visits to perform field inspections and make water analysis on site. Visits shall be twice annually for closed systems and monthly for steam systems. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit copies of the field service report after each visit to the Government and to the Contractor. Any problems related to the operation of the chemical treatment program shall be reported to the Government.
2. Provide laboratory and technical assistance services for warranty period.
3. Include a two (2) hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.

4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.
5. Provide sufficient chemicals for treatment and testing during warranty period.

B. The Contractor shall add the chemical solutions required for cleaning the closed loop heating piping system as well as the new steam and condensate piping systems. During the remainder of the warranty period, the Contractor will be responsible for adding chemicals and ensuring proper water treatment is maintained. The Contractor shall make periodic tests of the chemical treatment program as called for above and recommend changes to Government when needed.

1.9 WATER ANALYSIS

A. Sample feedwater to determine appropriate chemical treatment. Contact the Government if test indicates treatment required is different than that specified.

PART 2 - PRODUCTS

A. MANUFACTURERS
1. ChemTreat
2. Illinois Water Treatment Services
3. Nalco

2.2 MATERIALS

A. Closed System Water Treatment:

1. Provide one bypass feeder on each system. Install inlet, outlet and drain valves, and necessary piping.
2. Provide a 3/4" water meter in the domestic cold water line that provides makeup water to hydronic systems.
3. Provide coupon rack around main system pumps for all systems
4. Proprietary blend containing the following items:

a. Corrosion Inhibitors for Water Systems Operating Above 145°F: Sodium nitrite-borax or molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 1,000 ppm nitrite or 100 ppm molybdate. Adjust borax content to keep correct pH for type of system. Though the system is mainly steel or copper, aluminum is present (aluminum fintube). Inhibitors shall be selected to properly protect aluminum. pH shall not exceed 8.5 to avoid disruption of the aluminum oxide film.
b. Corrosion Inhibitors for Heating Systems operating at ≤ 145°F:Sodium molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 50 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).

c. Scale Inhibitor: Organic phosphonates such as aminomethylene-phosphonate; phosphonates such as hydroxyethylidenediphosphonate or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, poly-methacrylates and polyacrylanides. Inorganic phosphates are not acceptable. Maintain residual concentration as recommended by the manufacturer.

2.3 EQUIPMENT

A. Bypass (Pot) Feeder: 5.0 gal; quick-opening cap with 3-1/2" minimum diameter opening and opening wrench, legs to raise fill cap to 30" to 36", drain valve, air cock, working pressure of 200 psig at 200°F, 20 to 25-micron cartridge or bag filter.

1. Acceptable Manufacturers:

a. Griswold
b. Vector Industries
c. J.L. Wingert
d. Neptune

B. Water Meter: Positive displacement type meter with bronze housing. 3/4" meter size. Meter to handle 1/2 - 30 GPM.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bypass (pot) feeder with top approximately 36" above the floor.

C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall system volume. Notify Government of overall system volume so that expansion tank sizing can be confirmed.

3.2 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS

A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic systems within the more stringent of either the equipment manufacturer's requirements or those listed below:

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
pH Range	8.5	8.5	9.0
Alkalinity as $CaCO_3$	100 - 500 mg/l	100 - 500 mg/l	100 - 500 mg/l
Hardness as $CaCO_3^*$	100 - 500 mg/l	100 - 500 mg/l	100 - 500 mg/l
Suspended Solids	less than 10 mg/l	less than 10 mg/l	less than 10 mg/l

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
Dissolved Solids	less than 1,000 mg/l	less than 1,000 mg/l	less than 1,000 mg/l
Chlorides	less than 150 mg/l	less than 150 mg/l	less than 150 mg/l
Iron	less than 5.0 mg/l	less than 5.0 mg/l	less than 5.0 mg/l
Manganese	less than 0.4 mg/l	less than 0.4 mg/l	less than 0.4 mg/l
Nitrate	less than 100 mg/l	less than 100 mg/l	less than 100 mg/l
Sulfate	less than 200 mg/l	less than 200 mg/l	less than 200 mg/l
Ammonia	less than 5.0 mg/l	less than 5.0 mg/l	less than 5.0 mg/l
Free Copper	less than 0.10 mg/l	less than 0.10 mg/l	less than 0.10 mg/l

B. Submit an independent third-party test report for each chemically treated closed-loop system showing compliance with all measured values shown in the above table as part of project closeout documentation.

C. Circulate water and verify proper chemical and especially biocide levels for six (6) hours prior to starting fans if system has been out of service.

END OF SECTION 23 25 00

SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork

B. Aluminum Ductwork

C. Stainless Steel Ductwork

D. Phenolic Non-Fibrous Closed Cell Ductwork

E. Ductwork Reinforcement

F. Ductwork Sealants

G. Rectangular Ductwork

H. Round and Flat Oval Ductwork

I. Exposed Ductwork

J. Flexible Duct

K. Autoclave Exhaust Duct

L. Leakage Testing

M. Ductwork Penetrations

N. Painting

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.

D. ASHRAE - Handbook 2020 Systems and Equipment; Chapter 19 - Duct Construction.

E. ASHRAE - Handbook 2021 Fundamentals; Chapter 21 - Duct Design.

F. ASTM A90 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

G. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

H. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

J. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

L. ASTM E413-87 - Classification for Rating Sound Insulation.

M. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.

N. AWS D9.1M/D9.1 - Sheet Metal Welding Code.

O. IECC - International Energy Conservation Code (latest published edition)

P. NADCA Standard 05 1997 - Requirements for the Installation of Service Openings in HVAC Systems.

Q. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

R. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.

S. SMACNA - Air Duct Leakage Test Manual.

T. SMACNA - HVAC Duct Construction Standards.

U. SMACNA - Phenolic Duct Construction Standard 022.

V. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.

W. UL 181 - Factory-Made Air Ducts and Air Connectors.

X. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors

Y. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submit duct fabrication standards in compliance with SMACNA and these specifications. Clearly indicate metal gauges, reinforcement, and joining methods intended for use for each pressure classification. Furnish details of all common duct fittings and joint connections to be used on this project.

C. The Government may require field verification of sheet metal gauges and reinforcing to verify compliance with these specifications. At the request of the Government, the contractor shall remove a sample of the duct for verification. The contractor shall repair as needed.

D. Duct Layout Drawings: Submit detailed duct layout drawings at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
2. Differentiate ducts that are wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
3. Room names and numbers, ceiling types, and ceiling heights.
4. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
5. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of ventilation drawings for contractor's use if the contractor signs and returns the "Electronic File Transfer" waiver. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Refer also to Section 23 05 00.

E. Duct Leakage Test Summary Report: Upon completion of the pressure test described in Part 3, the Contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

1.4 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

C. Exterior Duct: Ductwork located outside the conditioned envelope including exposed ductwork above the roof, outside exterior walls, in attics above insulated ceilings, inside parking garages, and crawl spaces.

D. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

1.5 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD drawings to be provided to Contractor for inclusion into composite coordination drawings.

B. Duct drawings shall be at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
2. Differentiate ducts that are lined or wrapped. Include insulation thickness and type of insulation.
3. Location and size of all duct access doors.
4. Room names and numbers, ceiling types, and ceiling heights.
5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

6. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND SUPPORTS

A. Rectangular Duct - Single Wall:

1. General Requirements:

   a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
   b. Transitions shall not exceed the angles in Figure 4-7.

2. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

   a. All ducts shall be cross-broken or beaded.
   b. Snap lock seams are not permitted.
   c. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

      1) Type 1:

         a) Description: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
         b) Usage: Limited to 3,000 fpm and vane lengths 36" and under.

      2) Type 2:

         a) Description: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
         b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

      3) Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):

         a) Description: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.
         b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

      4) Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

5) Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.
6) Omitting every other vane is prohibited.

d. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Mitered elbows (with or without turning vanes) may not be substituted for radius elbows. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.
e. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
f. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.
g. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.
h. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
i. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
j. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.
k. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

1) Apply sealant to all inside corners. Holes at corners are not acceptable.
2) Manufacturers:

a) Ductmate Industries - 25/35/45
b) Nexus
c) Mez
d) WDCI
e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

l. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

1) Apply sealant to all inside corners. Holes at corners are not acceptable.

2) Flanges shall be 24-gauge minimum (not 26 gauge).
3) Manufacturers:

a) Lockformer TDC
b) TDF
c) United McGill
d) Sheet Metal Connectors
e) Other manufacturers must submit test data and fabrication standards and receive Government's approval before any fabrication begins.

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

2. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
3. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
4. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
5. Ductwork shall be suitable for velocities up to 5,000 fpm.
6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
8. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
9. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
10. Transverse Joint Connections:

a. Crimped joints are not permitted.
b. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
c. Ducts and fittings larger than 36" shall have flanged connections.
d. Secure all joints with at least 3 sheet metal screws before sealing.
e. Manufacturers, Slide-on Flanges:

1) Ductmate Industries - SpiralMate
2) Accuflange
3) Sheet Metal Connectors are acceptable.

f. Manufacturers, Self-Sealing Duct Systems:

1) Lindab
2) Ward "Keating Coupling"

C. Hangers and Supports General Requirements:

1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
2. Strap Hangers: Strap hanger shall be a minimum of 1 inch, 18 gauge attached to the bottom of ducts.
3. Cable Hangers:

a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.
b. Manufacturers; Supports:

1) Gripple
2) Ductmate
3) Duro Dyne
4) Government approved

4. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs.. Install per manufacturer's ratings and instructions.

a. Manufacturers; Supports:

1) EZ Hanger

2.2 MATERIAL AND APPLICATION SPECIFICATIONS

A. Galvanized Steel:

1. General Requirements:

a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
c. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
d. Ductwork reinforcement shall be of galvanized steel.

2. Duct Hangers and Support Material:

a. Ductwork hangers and supports shall be of galvanized or painted steel.
b. All fasteners shall be galvanized or cadmium plated.

B. Aluminum Ductwork:

1. General Requirements:

a. Material: ASTM B209; aluminum sheet, Alloy 3003-H14. Aluminum connectors and bar stock: Alloy 6061-T6. Aluminum or stainless steel fasteners are acceptable.
b. All duct gauges and reinforcement shall be as called for in Tables 2-50, 2-51, 2-52, and 3-14 of the SMACNA HVAC Duct Construction Standards.
c. Ductwork reinforcement shall be of aluminum.

2. Duct Hangers and Supports Material:

a. Ductwork hangers and supports shall be of aluminum. Slip cable hangers are acceptable if constructed of aluminum.
b. All fasteners shall be aluminum.

C. Stainless Steel Ductwork:

1. General Requirements:

a. Ductwork shall be Type 304L stainless steel, 16 gauge minimum.
b. Exposed ductwork shall have a #3 finish. Concealed ductwork may have milled finish.
c. Ductwork reinforcement shall be of stainless steel.

2. Duct Hangers and Supports Material:

a. Ductwork hangers and supports shall be of stainless steel. Slip cable hangers are acceptable if constructed of stainless steel.
b. All fasteners shall be stainless steel or cadmium plated steel.

D. Duct Hangers and Support Material:

1. Ductwork hangers and supports shall be of galvanized or painted steel.
2. All fasteners shall be galvanized or cadmium plated.

E. Phenolic Non-Fibrous Closed Cell Ductwork - Indoor:

1. General Requirements:

a. Phenolic duct shall be constructed per the latest edition of the SMACNA Phenolic Duct Construction Standard 022.
b. Material: CFC-free, closed cell rigid thermoset resin thermally bonded to aluminum foil faced fiberglass scrim inside and out. 3.4 lb./cu.ft. density. Minimum compressive strength of 28 psi.
c. Insulation:

1) Thermal Conductivity: 0.13 maximum 'K' value at 75°F.
2) Minimum R-Value = 8.0.

d. Rated Velocity: ≤ 5000 FPM

e. Rated Pressure:

1) Positive: 3" w.c.
2) Negative: 3" w.c.

f. Flame spread/smoke developed ratings of less than 25/50 per ASTM E84.

2. Closure Materials:

a. Duct system shall be connected and sealed per manufacturer's recommendations to meet the leakage, pressure class, and velocity noted in these specifications.

3. Install hangers and supports per manufacturer's recommendations.

F. Phenolic Non-Fibrous Closed Cell Ductwork - Outdoor:

1. General Requirements:

a. Material: CFC-free, closed cell rigid thermoset resin, 3.4 lb./cu.ft.. Minimum compressive strength of 28 psi. Inner shell shall be thermally bonded aluminum foil faced fiberglass scrim. Outer shell shall be white UV resistant 0.039" high impact resistant vinyl or 200-micron aluminum wrap.
b. Insulation:

1) Thermal conductivity: 0.130.018 W/(m K) maximum 'K' value at 75°F.
2) Minimum R-Value = 14.1

c. Rated Velocity: ≤ 5000 FPM

1) Rated Pressure:
2) Positive: 4"w.c.
3) Negative: 3"w.c.

d. Flame spread/smoke developed ratings of less than 25/50 per ASTM E84.

2. Closure Materials:

a. Duct system shall be connected and sealed per manufacturer's recommendations to meet the leakage, pressure class, and velocity noted within these specifications.

3. Install hangers and supports per manufacturer's recommendations.

G. Exposed Ductwork (Rectangular, Round, and Flat Oval):

1. The following applies to all ductwork exposed in finished areas in addition to requirements noted above:

a. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.
b. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.
c. Remove all identification stickers and thoroughly clean exterior of all ducts.

d. Locate fitting seams on least visible side of duct.
e. Provide exterior finish suitable for field painting without further oil removal.
f. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct.
g. The system shall be free of visible dents and scratches when viewed from normal occupancy.
h. All insulation shall be internal, except at reheat coils.

2. Hangers for Exposed Ductwork:

a. Round Ducts:

1) Threaded rod with duct fixing bracket and metal strap. Provide single threaded rod centered on the duct. Strap hanger shall be a minimum of 1 inch, 18 gauge galvanized steel wrapping the circumference of the duct. Spacing as required by SMACNA guidelines, but no greater than 8' on center.

2) Aircraft cable with 2-point support in standard horseshoe arrangement.

b. Rectangular Ducts:

1) Aircraft cable and slip cable hangers are acceptable for ducts up to 18" in maximum dimension. Corner saddles are required when supporting rectangular ductwork. Spacing and cable size as required by SMACNA guidelines.

a) Manufacturers, Supports: Gripple, Ductmate, Duro Dyne, Architect/Engineer approved.

2) Aircraft cable with 2-point support in standard horseshoe arrangement. Corner saddles are required when supporting rectangular ductwork.

c. Strut-channel and all-thread rod is not acceptable for exposed ductwork.
d. All fasteners shall be galvanized or cadmium plated.

2.3 DUCTWORK REINFORCEMENT

A. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.

1. Ducts must be over 18" wide.
2. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
3. Tie rods must not exceed 1/2" diameter.
4. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.4 DUCTWORK SEALANTS

A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.

D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.

E. Supply ductwork shall be free of construction debris, and shall comply with Level "C" of the SMACNA Duct Cleanliness for New Construction Guidelines.

F. Repair all duct insulation and liner tears.

G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

J. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

K. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.

L. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

M. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

N. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

3.2 DUCTWORK APPLICATION SCHEDULE

A. Refer to Ductwork Application Schedule below for specific requirements for system, material, shape, pressure class, seal class and insulation application.

B. All interior and exterior ductwork shall meet the requirements for "exposed ductwork."

C. Pesticide Room Exhaust Duct:

1. Shape:

   a. Rectangular Duct - Single Wall
   b. Round and Flat Oval Spiral Seam Ductwork - Single Wall

2. Material: Stainless steel
3. Pressure Class: -1"
4. Seal Class: A
5. Insulation: 1 1/2" thick Type B (R=6.0)
6. Additional Requirements: None

D. Greenhouse Bay Purge Exhaust Duct:

1. Shape:

   a. Rectangular Duct - Single Wall

2. Material: Aluminum
3. Pressure Class: -2"
4. Seal Class: A
5. Insulation: 1-1/2" thick Type B (R=6.0) from greenhouse bay wall across circulation corridor to exterior wall penetration.

E. Autoclave Hood Exhaust Duct:

1. Shape: Rectangular Duct - Single Wall
2. Material: Stainless steel
3. Pressure Class: -1"
4. Seal Class: A
5. Insulation: 1-1/2" thick Type B (R=6.0) from hood to penetration at roof.

F. Louver/Damper Wall Sleeves:

1. Shape: Rectangular Duct - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: N/A
4. Seal Class: A

G. 1 1/2" (40 mm)RTU Exterior Supply & Return Duct:

1. Shape: Rectangular Duct
2. Material: Phenolic Non-Fibrous Closed Cell Ductwork - Outdoor
3. Pressure Class: +4" supply, -2" return
4. Seal Class: A
5. Insulation: Refer to "Phenolic Non-fibrous Closed Cell Ductwork - Outdoor" requirements.

H. RTU Interior Supply & Return Duct:

1. Shape: Rectangular Duct
2. Material: Phenolic Non-Fibrous Closed Cell Ductwork - Indoor
3. Pressure Class: +4" supply, -2" return
4. Seal Class: A
5. Insulation: Refer to "Phenolic Non-fibrous Closed Cell Ductwork - Indoor" requirements.

3.3 SPECIAL INSULATION REQUIREMENTS

A. Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.):

1. Insulation:

a. ASHRAE 90.1-2022: 1-1/2" thick Type A (R=4.5)
b. IECC-2021: 1-1/2" thick Type A (R=4.5)

B. Duct Mounted Coil Headers:

1. Insulation: 1-1/2" thick Type A (R=4.5)

3.4 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

D. Special Requirements for Dedicated Outside Air Systems (DOAS):

1. Apply aluminum-based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant.
2. Apply aluminum-based adhesive sealant tape on TAB boxes (all seams and joints of the box and duct connections) serving dedicated outside air supply (DOAS) system.

3.5 TESTING

A. Interior Duct - Less than 3" WG (positive or negative):

1. Leak testing of these pressure classes is not normally required for interior ductwork (inside the building envelope). However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Interior Duct - 3" WG and Above (positive or negative):

1. A minimum of 25% of interior ductwork (inside the building envelope) shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Duct system shall be completely pressure tested or aerosol sealed and tested. If duct has outside wrap, testing shall be done before it is applied.
3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
4. Seal ducts to bring the air leakage into compliance.
5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Exterior Duct - 1/2" WG and Above (positive or negative):

1. All exterior ductwork (outside the building envelope) shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.
2. All exterior ductwork (outside the building envelope) shall be completely pressure tested or aerosol sealed and tested. If duct has outside wrap, testing shall be done before it is applied.
3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.
5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

D. Pressure Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

   a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
   b. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
   c. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
   d. All joints shall be felt by hand, and all discernible leaks shall be sealed.
   e. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
   f. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
   g. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
   h. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
   i. Positive pressure leakage testing is acceptable for negative pressure ductwork.

E. Aerosol Sealed and Tested Procedure

1. Duct Preparation
   a. Inspect air distribution systems for major leakage sites and significant accumulation of hubris or debris.
   b. Remove all debris and significant dust and dirt (>1/8 inch deep) in air distribution system using NADCA approved duct cleaning method.
   c. Ensure adequate structural support for new and existing ductwork, including structural integrity of all mechanical duct joints and transitions per SMACNA standards.
   d. Temporarily remove or protect from aerosol particles building controls, fire and smoke sensors as recommended by manufacturer.
   e. Temporarily disable fire alarms and notify appropriate authorities.
   f. Temporarily isolate air-moving equipment and block off air inlets and outlets, and other devices and appurtenances as recommended by the manufacturer.
   g. Protect occupied spaces from aerosol particles using manufacturer procedures.
   h. All work shall be done in a substantial and workmanlike manner by factory trained technicians.
2. Duct Sealing
   a. Repair all major leakage sites greater than 1/2 inch across using mastic and fiberglass mesh tape per SMACNA standards.
   b. Mastic and fiberglass mesh tape shall meet UL 181 standards.
   c. Seal existing ductwork from the inside using automated aerosolized sealant injection.
      1) Manufacturer: Aeroseal LLC, 225 Byers Rd., Miamisburg, OH 45342, 937-428-9300, www.aeroseal.com

2) Application must be performed by a manufacturer approved service provider.
3) Sealant shall comply with UL Outline Scope 1381.
4) Sealant must cure with 2 hours with no VOC off-gassing thereafter.
5) Sealant shall remain elastic after curing.
6) Sealant shall be deposited substantially at areas of leakage only.

d. Provide pre-sealing, post-sealing and sealing profile reports for all duct sections sealed.
e. Repair all injection and test holes in existing ductwork using patching plates sealed tight per SMACNA standards.
f. Any injection ports in duct board shall be made and repaired using pump-kin-cuts.
g. Any insulation (internal or external) shall be replaced on the patching plate.

3. Duct Testing
   a. Provide pre-sealing and post-sealing leakage profile reports indicating percentage reduction of leakage for supply, return and exhaust ductwork and shafts.
   b. Use manufacturer calibrated blower fan box with digital manometer to measure leakage before and after sealing.
   c. Following completion of air handling unit installations, duct repairs, and duct sealing, test all ductwork to ensure that the air distribution system is properly sealed.
      1) The supply ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
      2) The return ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
      3) The exhaust ducts shall have air losses of less than 5% of the total air flow volume measured at the fan or air-moving device.
      4) Ducts shall be leak tested at a static pressure that is as close as possible to the system average operating static pressure. Duct test pressure should not exceed the lesser of the duct static pressure construction class, the duct system design static pressure or 2.5 in. w.g.
4. Duct Reassembly and Cleanup
   a. Reinstall building controls and smoke detectors.
   b. Enable fire alarms and notify appropriate authorities.
   c. Remove blocking, reinstall grills and registers, and enable air handling fans.
   d. Cleanup sealant residue that may have adhered to surfaces in occupied areas as recommended by the Manufacturer.
   e. All work shall be done in a substantial and workmanlike manner by factory-trained technicians
5. Warranty
   a. The Contractor shall warrant that the aerosol sealant application will be free of defects for a period of 3 years from date of the sealing application. If defects should occur during this period, the Contractor shall repair or replace the defective duct seals, including the direct labor costs for performing the repair or replacement, at no additional cost to the Owner.

3.6 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with the Government.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

3.7 PAINTING

A. Paint interior of ducts black within twice the largest duct dimension of inlets and outlets where interior of duct is visible.

B. Paint bottom of ducts black within twice the largest duct dimension where a duct is routed above an unducted perforated grille and the duct is visible.

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Volume Dampers.

B. Backdraft Dampers.

C. Fabric Connectors.

D. Duct Access Doors.

E. Duct Test Holes.

F. Temperature Control Dampers.

1.2 REFERENCES

A. AMCA Guide for Commissioning and Periodic Performance Testing of Fire, Smoke and Other Life Safety Related Dampers.

B. ASTM E477-20 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. NFPA 72 - National Fire Alarm and Signaling Code

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

E. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

F. SMACNA - HVAC Duct Construction Standards (latest edition).

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

E. Provide locking quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

H. Contractor assembled modular manual dampers are acceptable as long as it contains the components listed above.

2.2 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 inches x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.

B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90-degree stop, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Models:

1. Ruskin CBD4
2. Arrow 655
3. Safe-Air/Dowco BRL
4. Greenheck EM.

2.3 FABRIC CONNECTORS

A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.

B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalis, grease and gasoline, and shall be noncombustible.

D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.

E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

F. Fabric connectors shall not be painted.

G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.

H. Materials:

1. Durodyne MFN-4-100
2. Vent Fabrics, Inc.
3. "Ventglas"
4. Proflex PFC3NGA

I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.

J. Materials:

1. Durodyne "Duralon MFD-4-100"
2. Vent Fabrics, Inc.
3. "Ventlon"
4. Proflex PFC3HGA

2.4 DUCT ACCESS DOORS

A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Minimum size for access doors shall be 24" x 16" or full duct size, whichever is less.

F. Provide duct access door in all horizontal return ductwork at 20 foot intervals per NFPA 90A.

2.5 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.6 DUCTWORK ACCESSORY SEALANTS

A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.

2.7 CONTROL DAMPERS AND DAMPER ACTUATORS

A. Control dampers and damper actuators shall be furnished and installed by the Contractor (Section 23 0 900).

B. Coordinate exact sizes, locations, and installation requirements before ordering.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.
2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Government.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Grease duct access doors shall be installed per approvals from manufacturer's ICC-ES Evaluation Report.
6. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Government.

C. Control Dampers and Damper Actuators:

1. Install control dampers and damper actuators in accordance with manufacturer's instructions.
2. Seal around damper frame inside ductwork with duct sealant to prevent bypass around damper.
3. Provide duct access door at each control damper.

END OF SECTION 23 33 00

SECTION 23 34 23 - POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof Exhaust Fan.

B. Rooftop Fan Curbs.

C. Wall Exhauster.

1.2 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

D. Fan Energy Index (FEI): Fans shall meet or exceed the minimum FEI scheduled at the specified airflow, pressure, and air density (duty point). In no case shall the FEI at the specified duty point fall below 1.0.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 208 - Calculation of the Fan Energy Index (FEI).

C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

D. AMCA 230 - AMCA 230 - Laboratory Methods of Testing Air Circulating Fans for Rating and Certification.

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

G. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

H. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

I. SMACNA - HVAC Duct Construction Standards (latest edition).

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include data on all fans and accessories. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point (ceiling and HVLS fans are exempt from FEI submittal requirements).

B. Submit manufacturer's installation instructions.

C. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

D. Submit motor data indicating compliance with Section 23 05 13.

1.5 EXTRA STOCK

A. Provide one (1) extra belt set for each fan unit.

PART 2 - PRODUCTS

2.1 ROOFTOP EXHAUST FAN - DIRECT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum or composite with backward inclined or airfoil blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. Any steel parts shall be galvanized or epoxy coated. Non-corrosive fasteners.

E. Direct drive, motor mounted outside of airstream and ventilated with outside air.

F. Aluminum or brass bird screen. Plastic mesh will not be allowed.

G. Mill aluminum finish.

H. Dampers: Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq. ft. @ 1" SP (or shall be AMCA Class 1 certified).

I. Motor (as scheduled on drawings):

1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.

a. Disconnect as scheduled on drawings.

2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless permanent magnet (PM) motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor and controller shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:

a. ECM set for constant CFM.

J. Speed Controller: For single phase shaded pole or permanent split capacity motor fans, furnish solid-state dial speed controller factory mounted inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.

K. Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

L. Manufacturers:

1. Greenheck "CUE"
2. Cook "ACE-D"
3. ACME PX
4. PennBarry DX
5. Twin City DCRU

2.2 ROOFTOP FAN CURBS

A. Furnish and install prefabricated roof curbs for all rooftop fans.

B. Size curb to match the curb cap of fan.

C. Roof Mounting Curb: Curb height as shown on drawings, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.

D. Construction: Unitized construction, continuous arc welded corner seams. Insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board. Damper support angle. Pressure treated wood nailer. Curb without cant.

1. 18-gauge galvanized steel.

E. If called for in the drawings, curbs shall be of the sound attenuation type. Sound attenuation curbs shall reduce the fan sone rating by at least 40% and not decrease fan cfm more than 8% (which is accounted for in the scheduled fan cfm). Baffles shall be removable for access to the dampers.

F. Manufacturers:

1. Same manufacturer as the fan
2. Pate
3. RPS
4. Thy
5. Greenheck

2.3 WALL EXHAUST FAN - DIRECT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. Any steel parts shall be galvanized or epoxy coated. Non-corrosive fasteners.

E. Direct drive, motor mounted outside of airstream and ventilated with outside air.

F. Aluminum or brass bird screen. Plastic mesh will not be allowed.

G. Air-dried enamel custom color selected by Government.

H. Dampers: Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs. Damper shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq.ft @1" SP (or shall be AMCA Class 1 certified).

I. Motor (as scheduled on drawings):

1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.

   a. Disconnect as scheduled on drawings.

2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless permanent magnet (PM) motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor and controller shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:

   a. ECM set for constant CFM.

J. Speed Controller: For single phase shaded pole or permanent split capacity motor fans, furnish solid-state dial speed controller factory mounted inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.

K. Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

L. Manufacturers:

1. Greenheck "CUE"

2. Cook "ACE-D"
3. ACME PX
4. PennBarry DX

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated lag screws to roof curb.

C. If manufacturer has no recommendations, secure roof exhaust fans to curbs with 1/4" lag bolts on 8" maximum centers.

D. Contractor shall install and wire factory provided damper to open when the fan runs if the manufacturer does not provide an option to pre-wire the damper.

END OF SECTION 23 34 23

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Autoclave Exhaust Hood.

B. Grilles and Registers.

C. Louvers.

1.2 QUALITY ASSURANCE

A. Test and rate performance of air inlets and outlets per ASHRAE 70.

B. Test and rate performance of louvers per AMCA 500L-99.

1.3 REFERENCES

A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.

B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. SMACNA - Duct Construction Standards.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.

C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

D. Submit manufacturer's installation instructions.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 AUTOCLAVE EXHAUST HOOD

A. Complete ceiling hung vapor hood.

B. Hood shall be 18 gauge, Type 304 stainless steel construction, #3 polish finish, with continuously welded exterior seams ground and polished to match hood.

C. Provide removable interior baffles to allow condensation to drain to perimeter drain trough.

D. Unit shall have NSF label and UL label in accordance with NFPA-96.

E. Provide 1" drain connection. Extend 1" copper drain piping to nearest floor drain.

F. Manufacturers:

1. Greenheck
2. Kees Incorporated
3. Econovent
4. Captive Aire

2.2 AIR TERMINALS - GRILLES AND REGISTERS

A. Reference to a grille means an air supply, exhaust or transfer device without a damper.

B. Reference to a register means an air supply, exhaust or transfer device with a damper.

C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.

D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

E. The capacity and size of the unit shall be as shown on the drawings.

F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.

G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.

H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.

J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.

K. Where specified to have filters, provide with filter rack suitable for 2" thick MERV-8 pleated media filters. Grille border shall be fabricated from minimum 22 gauge steel or minimum 0.040-inch thick for aluminum grilles. Provide removable grille face with metal knurled knob or quarter turn fastener to allow for filter media replacement.

L. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.

M. Manufacturers:

1. Titus
2. Price
3. Nailor
4. Krueger

2.3 LOUVERS - FIXED - ALUMINUM

A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

F. Contractor shall coordinate the exact placement and flashing of all louvers with the architectural plans.

G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

H. Louvers shall be suitable for duct connection.

I. Manufacturers:

1. Arrow - "EA-415-D"
2. Ruskin - "ELF375DX"
3. Greenheck - ESD "403"

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install items in accordance with manufacturers' instructions.
2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
3. Install diffusers to ductwork with air-tight connections.
4. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

C. Maintaining Duct Cleanliness:

1. When grilles, registers, and diffusers are installed, Contractor shall prevent construction dust, dirt, and debris from entering ductwork as required by Section 23 05 00.

END OF SECTION 23 37 00

SECTION 23 40 00 - AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filters and Filter Media.

B. Side Access Filter Housings.

C. Filter Gauges.

1.2 QUALITY ASSURANCE

A. Filter media shall be tested under ANSI/UL 900 and labeled.

B. Provide all filters and filter banks by one manufacturer.

1.3 REFERENCES

A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

B. ANSI/UL 900 - Test Performance of Air Filter Units.

C. ASHRAE 26 - Guideline for Field Testing of General Ventilation Devices and Systems for Removal Efficiency In-Situ by Particle Size and Resistance to Flow.

D. ASHRAE 52.2 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter. Appendix J (for MERV-A rating)

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include data on media, performance, assembly and frames.

1.5 EXTRA STOCK

A. Provide a total of three (3) sets of filters for all units.

1. Provide clean filters in all units at time of installation.
2. Provide clean filters in all units at project final completion after all interior finishes are complete.
3. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

PART 2 - PRODUCTS

2.1 MERV 8 (MEDIUM EFFICIENCY) - DISPOSABLE - TYPE D

A. Pleated media, disposable type with welded wire grid support bonded to the filter media.

B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.

C. 2" thick media with at least 4.6 square feet of media per square foot of face area. MERV 8 per ASHRAE 52.2. Maximum initial resistance of 0.30" WG at 500 fpm face velocity.

2.2 MERV 17 (99.97% EFFICIENT) HEPA FILTER - TYPE K

A. Disposable pleated glass fiber paper media with aluminum separators. Galvanized steel frame.

B. Maximum depth of 12". At least 43 square feet of media per square foot of face area.

C. Minimum efficiency of 99.97% on 0.3 micron and larger particles per ANSI/UL 586. Maximum 1.35" WG initial resistance at 250 fpm face velocity.

D. Manufacturers:

1. Camfil
2. American Air Filter

2.3 SIDE ACCESS FILTER HOUSING

A. Refer to Filter Schedule and drawings for filter housing size, pre-filter and HEPA filter sizes, and duct inlet and outlet configuration, and access door orientation.

B. 16 gauge welded and caulked aluminum construction with bracing and pre-punched standing flanges on inlet and outlet.

C. Full size, hinged access doors on each end of housing with 16 gauge galvanized steel, reinforced, positive sealing heavy duty latches and resilient gasketing.

D. 16 gauge galvanized steel or extruded aluminum holding tracks. "U" shaped bearing channel. Replaceable woven pile seals for filters.

E. Filter channel suitable for 2" thick MERV 8 prefilter and cartridge type HEPA filter.

F. Manufacturers:

1. Camfil
2. American Air Filter

2.4 FILTER GAUGES

A. Differential Pressure Gauge: Diaphragm actuated, nominal 3" round dial, glass filled nylon housing, polycarbonate lens, zero adjustment, 0-2" W.G. range, 5% of full scale accuracy.

B. Accessories: Static pressure tips with integral compression fittings and 1/8" NPT plastic tubing.

C. Manufacturers:

1. Dwyer "Minihelic II" 2-5000
2. Marshalltown Instrument "Series 85C"

2.5 HIGH EFFICIENCY FILTER TEST HOLE

A. 1-1/2" gasketed instrument type test hole with heavy screw cap.

B. Manufacturers:

1. Ventlok 699 or equivalent

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturers' instructions.

B. Seal filter media to prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan systems without filters.

D. Install static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and calibrate. Every filter bank, including packaged units, shall have a filter gauge.

E. Install four (4) high efficiency filter test holes, two upstream and two downstream, at all high efficiency filter banks in air handling units and ductwork (85% efficiency and higher). Coordinate location of test holes with the Government.

END OF SECTION 23 40 00

SECTION 23 74 16.12 - PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Rooftop Units

1.2 QUALITY ASSURANCE

A. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).

B. All units must be UL or ETL listed and must contain UL labeled components.

C. Fans shall be tested and rated in cabinet in accordance with AMCA Standard 210. All fan assemblies shall be dynamically balanced in cabinet at final assembly.

D. Conform to ASHRAE 90.1.

E. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AHRI 210 - Unitary Air Conditioning Equipment.

B. AHRI 240 - Air Source Unitary Heat Pump Equipment.

C. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

D. ASHRAE 37 - Methods of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment.

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Installation of Air Conditioning and Ventilating System.

H. UL - Underwriters' Laboratory.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Indicate electrical service and duct connections on shop drawings or product data.

C. Submit manufacturer's installation instructions.

D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

E. Submit fan curves, including minimum and maximum fan speed, with specified operating points clearly plotted.

F. Provide 8 octave maximum sound power levels at unit discharge and return connection.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, installation instructions, maintenance and repair data, and parts listing.

1.7 WARRANTY

A. Provide five (5) year manufacturer's warranty for compressors.

B. Provide three (3) year manufacturer's warranty for controls and electrical components (thermostats, VFD, etc.).

1.8 MAINTENANCE SERVICE

A. Contractor shall furnish complete service and maintenance of packaged roof top units for one year from Date of Substantial Completion.

B. Provide maintenance service with a two-month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of four (quarterly) filter replacements, minimum of one fan belt replacement, and controls checkout, seasonal adjustments, and recalibrations.

D. Submit copy of service call work order or report and include description of work performed to Owner and Architect/Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The scheduled manufacturer is the Basis of Design. The Contractor is responsible for all costs, schedule impacts, and construction coordination, including design costs and regulatory agency approvals, related to using a specified alternate product other than the Basis of Design. Refer to Section 23 05 00 for additional information.

B. Acceptable Manufacturers:

1. Captive Aire
2. Trane Horizon
3. The RTUs are for special applications requiring specific dimensions, configurations, components, and control sequences, so only pre-approved manufacturers will be allowed.

2.2 MANUFACTURED UNITS

A. Provide roof-mounted units having electric heating elements, and electric refrigeration.

B. Unit shall be self-contained, packaged, factory assembled, pre-wired and tested, consisting of cabinet and frame, supply fan, exhaust fan, electric heating elements, controls, air filters, refrigerant cooling coil and compressor, condenser coil, condenser fan, and a full refrigerant charge.

C. Unit shall be furnished with non-fused disconnect switch, short fuse protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

D. AHRI rated for direct expansion use with R-32 or R-454B.

E. Refrigerant Detection System (RDS)

1. Units manufactured using A2L refrigerants (e.g. R-32, R-454B) shall include a Refrigerant Detection System (RDS) with one or more refrigerant detection sensors to detect leaked refrigerant within the conditioned air stream in compliance with UL 60335-2-40. Minimum Safety Measures Activation shall include: Activating ventilation systems or fans to disperse refrigerant, disabling electrical ignition sources and issuing alarms or notifications.

2.3 FABRICATION

A. Cabinet: Galvanized steel with baked enamel finish, access doors with quick fasteners locking door handle type with piano hinges**.** . Access doors shall be provided at each section (e.g., filter section, supply fan section, etc.). All exterior access must be permanently labeled on the outside indicating what is behind the panel. Structural members shall be minimum 18 gauge, with access doors of minimum 20 gauge.

B. Outside Air Intakes: The outside air intakes shall be located a minimum of 15 inches above the roof mounting curb to minimize the effect of heat pickup from the roof during the natural cooling cycle and the effects of snow on the roof during winter operation. Each air intake shall be furnished with rain eliminators.

C. Insulation: All sections shall be double wall, foam injected casings.

D. Air Filters: Suitable for 12" HEPA filters with airtight seals.

2.4 ROOF / GRADE MOUNTING FRAME AND BASE

A. Refer to plans for RTUs located on grade or roof.

B. Roof Mounting Curb: Minimum 24 inches high, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer. Curbs mounted on the roof shall have R-13 insulation.

2.5 FANS/MOTORS

A. Fans:

1. Supply Fans: centrifugal; SWSI plenum or vane axial fan.
2. Exhaust Fans: Propeller or SWSI plenum fan.
3. All fans shall be aluminum or composite construction with fan shaft: turned, ground and polished steel; keyed to wheel hub.
4. Fan and motor assemblies shall be resiliently mounted.
5. Direct drive motor.
6. All fan bearings must be capable of being lubricated by easily accessible grease fittings.
7. All fans must be statically and dynamically balanced.

B. Motors:

1. Motors shall be open drip-proof with grease lubricated bearings.
2. No equipment shall be selected or operate above 90% of its motor nameplate rating.
3. Motor shall have 1.15 service factor.

C. Belt Drive Fans:

1. Belt drive fans must be within ± 10% of scheduled RPM.
2. Belt drive fans shall have slide rails, adjusting screws, anchor bolts, and bedplates.
3. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.
4. Units used with variable speed drives shall have fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

2.6 ELECTRIC HEATING COIL

A. Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, control circuit transformer and fuse, manual reset thermal cut-out, airflow proving device, toggle switch (pilot duty), and fused disconnect.

B. Controls shall start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

C. Heating shall have modulating SCR control.

2.7 EVAPORATOR COIL

A. Provide copper tube with aluminum fin coil assembly.

B. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

D. Provide insulation on liquid refrigerant and suction piping between compressor and evaporator coil where not protected by drain pans. Insulation shall be elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

E. Drain Pan Condensate Overflow Switch: Float with integral magnet overflow switch conforming to UL508. Factory installed in drain pan and wired to shut the rooftop unit down with a fault alarm. No standby power required.

2.8 HOT GAS REHEAT COIL

A. Provide copper tube with aluminum fin coil assembly.

B. Valves to reroute hot refrigerant gas from the discharge line of the compressor through the reheat coil.

2.9 COMPRESSOR

A. Provide hermetic or semi-hermetic compressors (quantity as scheduled on drawings), 3600 rev/min maximum, resiliently mounted with positive lubrication, crankcase heater for operation down to 0°F, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

B. Provide capacity control by staging multiple compressors, digital scrolls, inverter duty scroll compressors.

C. Five minute timed off circuit shall delay compressor start.

D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

E. The use of hydrochlorofluorocarbon (HCFC) or chlorofluorocarbon (CFC) based refrigerants is prohibited.

2.10 CONDENSER

A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.

B. Condenser Coil:

1. Round Copper Tube and Aluminum Fins: Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Air test under water to 450 psig.
2. Microchannel: All aluminum brazed fin construction. The maximum allowable working pressure of the condenser is 450 psig. Air test under water to 450 psig.

C. Condenser Fans: Provide direct drive low noise blade design propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be aluminum or composite material.

D. Condenser Motors: Fan motors shall be an ECM type motor for proportional control. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

E. Suction line accumulator for added protection against liquid entering suction line of compressor.

F. Bi-flow, low pressure drop, replaceable cartridge type filter drier.

G. Entire fan assembly shall be statically and dynamically balanced.

H. Provide refrigerant pressure switches to cycle condenser fans.

I. Provide hail guards on all condenser coils.

J. Liquid and discharge isolation valves with staged and digital scrolls.

2.11 MIXING SECTION

A. Dampers: Provide remote controlled outside and return air dampers with damper operator and remote rheostat for adjusting outside air quantity.

B. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to closed position. Relief dampers may be gravity balanced.

C. Gaskets: Provide tight fitting dampers with edge gaskets. Gaskets must be mechanically fastened (use of adhesive alone shall not be acceptable). Damper blades shall be gasketed with side seals to provide an air leakage rate of Class 1A at 1" w.c. pressure differential for a 24"x 24" damper. A barometric exhaust damper shall be provided to exhaust air out the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator.

D. Damper Actuator: 24 volt with gear train sealed in oil, with spring return.

2.12 VARIABLE FREQUENCY DRIVES (VFDs)

A. Provide VFD for speed control of all supply fans. Each drive shall be factory installed out of the airstream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.

B. All VFDs shall provide the following protections:
   1. Phase protection.
   2. Brownout protection.
   3. Overload/Overheat protection.
   4. Soft starts to protect bearings and hardware.
   5. Low and high voltage and over-torque protections.

2.13 ELECTRICAL

A. Provide with single point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet.

B. All units must be so constructed that when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120 volt duplex convenience outlet) is disconnected by means of a single disconnect**.**

C. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

D. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.

E. All units shall include a transformer for controls and convenience outlet.

F. Only one power cable connection to the unit shall be necessary.

G. Motor shall include phase failure protection and prevent the motor from operation in the event of phase loss.

H. Provide LED backlit, LCD Human-Machine Interface (HMI) mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.

I. Provide with remote HMI for each unit to allow for full programming capabilities. HMI shall be wired using standard CAT5/6 cables. Coordinate exact HMI mounting location with Government Representative. All wiring shall be installed in conduit. Coordinate HMIs and associated programming with Siemens.

2.14 DDC TEMPERATURE CONTROLS

A. Install standalone control module providing communication between unit controls and packaged DDC temperature control system.

B. Control module shall be compatible with temperature control system specified in Section 23 09 00. Provide BACnet gateway for communication. Coordinate gateway requirements with Siemens.

C. Refer to drawings M502 and M503 for RTU control diagrams and sequences. The RTUs shall be provided with all components and devices necessary to achieve the control sequences on drawings M502 and M503.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings and illustrated by the manufacturer.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate all RTU controls with Siemens.

C. Mount units on factory built roof mounting curb and provide watertight enclosure to protect ductwork and utility services. Install unit level.

D. All field wiring shall be in accordance with the National Electrical Code.

E. P-traps must be provided for all drain pans.

F. Comb all coils to repair bent fins.

G. Contractor shall coordinate unit access stair and walkway placement to ensure compliance with OSHA requirements.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shutdown during first year of operation.

END OF SECTION 23 74 16.12

SECTION 23 82 00 - TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Finned Tube Radiation.

B. Unit Heaters.

1.2 QUALITY ASSURANCE

A. All electrical equipment shall have a UL label.

B. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.

C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.

D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.

E. Submit manufacturers' installation instructions.

F. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 FINNED TUBE RADIATION

A. Refer to Radiation Schedule on Drawing M601 for material and performance requirements.

B. Refer to Drawing M401 for fintube details and supports. All fintube pipe fittings and supports shall be aluminum and provided by the fintube manufacturer.

C. Element hangers shall be quiet operating, cradle type.

D. Elements shall be aluminum tube with aluminum fins that are specifically designed for greenhouse applications. Provide with expanded aluminum covers over the fintube.

E. Acceptable Manufacturers:

1. Biotherm (Sunfin)

2.2 UNIT HEATERS

A. Casings shall be heavy gauge steel with a baked finish.

B. Coils shall have copper heads and tubes, and aluminum fins.

C. Units shall have threaded pipe connections for hanger rods.

D. Fans shall be direct drive propeller type, factory balanced, with fan guards and totally enclosed motors with integral thermal overload protection.

E. Horizontal units shall have adjustable outlet air louvers.

F. Provide unit mounted and wired disconnect switch. Contractor shall be responsible for providing and wiring disconnect when using a manufacturer who does not provide factory mounted option.

G. Products:

1. Trane - S or P
2. Daikin - UHH or UDH
3. Modine - HS or V
4. Vulcan - HV or VV
5. Sterling HS or VS
6. Zehnder-Rittling - H or V
7. Sigma H or V
8. Airtherm HA or VA

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

B. Install all products per manufacturers' instructions.
1. Coordinate recess sizes for recessed equipment.
2. Protect units with protective covers during construction.
3. Comb all coils to repair bent fins.

C. Fin Tube:

1. Locate finned tube radiation as shown on drawings and coordinate with ducts penetrating the greenhouse walls.
2. Install in accordance with manufacturer's recommendations.

D. Unit Heater:

1. Hang unit heaters from building structure, not from piping. Mount as high as possible within manufacturer's recommended mounting height requirements. If unit heaters cannot be installed within manufacturer's recommended range, notify Architect/Engineer prior to mounting.

3.2 CLEANING

A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

END OF SECTION 23 82 00

SECTION 23 84 13 - HUMIDIFIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric Steam Humidifier

1.2 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.3 REFERENCES

A. ANSI/ASTM - Boilers and Pressure Vessels Code.

B. ANSI/NFPA 70 - National Electrical Code.

C. AHRI 460 - Standard for Commercial and Industrial Humidifiers.

D. ASTM A105 - Forgings, Carbon Steel, for Piping Components.

E. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

B. Submit schedule indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.

C. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

D. Submit manufacturer's installation instructions.

E. Submit operation and maintenance data.

PART 2 - PRODUCTS

2.1 ELECTRIC STEAM HUMIDIFIER (IMMERSION TYPE)

A. Packaged unit, wall hung, electric steam generator.

B. Enclosure shall be an 18-gauge steel frame with cover suitable for finished spaces. Enclosure frame shall include a drip pan with a connection for drain piping. Separate compartments shall house electrical devices. The front exterior of the cabinet shall contain the microprocessor controller's digital keypad.

C. Cleanable vaporizing chamber shall be stainless steel with welded seams. The evaporating chamber shall be easily removable. Electrical, water supply, and drain connections shall have unions and plugs to allow convenient removal for cleaning and maintenance.

D. Steam outlet on top of tank shall be configured to connect to the space distribution unit.

E. Immersion heaters shall be Incoloy alloy-sheathed resistance type and shall be mounted on the vaporizing chamber's removable cover.

F. Water Requirements: The humidifier shall be capable of generating steam from R/O softened tap water.

G. Over-Temp Switch: A factory-mounted and wired sensor with manual reset shall sense an over-temperature condition and de-energize heater circuit controls.

H. An electric drain valve shall be mounted on the humidifier assembly to allow tank to automatically back flush and drain at the end of a humidification season. Units with 33 lbs./hr. or greater capacity shall include a flushing/drain pump.

I. Humidifier Controls:

1. Microprocessor controller with the following features or functions:

a. Makeup water switch control and low water safety shutdown.
b. Fully modulating (0% to 100%) control of humidifier via DDC system.
c. Self-diagnostic test at startup.
d. Auxiliary contacts to DDC system.
e. Duct-mounted humidity sensor.
f. Airflow proving switch. Unit shall not operate without proof of airflow.
g. Adjustable high limit duct humidity switch.
h. A unit-mounted keypad capable of monitoring and/or controlling the following parameters:

1) Relative humidity setpoint and actual conditions in space.
2) Relative humidity high level setpoint and actual conditions.
3) Total system demand in percentage of humidifier capacity.
4) Total system output in lbs./hr.
5) Drain/flush frequency interval and duration.
6) End-of-season drain status.
7) System alarms.
8) Previous fault messages.
9) Operating temperature.

2. Water Level Control: System shall provide for automatic refill, low water cutoff, field-adjustable skimmer bleed-off functions, and automatic drain-down of humidifier.
3. The humidifier supplier shall provide a space humidity sensor and shall coordinate its installation with the Contractor for control by the humidifier's microprocessor controls.

J. A thermostatically controlled water valve shall meter an amount of cold water into a mixing chamber to temper 212F water to a 140F discharge temperature to sanitary system.

K. Humidifier Dispersion, Space Distribution Unit:

1. A fan-based space distribution unit shall provide total internal steam absorption with no visible vapor.
2. Unit shall include an electric fan, fan control devices, steam inlet connection, and internal dispersion device.
3. The unit shall have a cabinet with exterior that matches the humidifier cabinet.
4. Unit shall be internally powered by the humidifier primary circuit.

L. Humidifier Dispersion, Duct Distribution Unit: Stainless steel dispersion tube or manifold to provide required steam distribution. Maximum total absorption distance not to exceed 3'-0".

M. Humidification system dispersion tube hot surfaces in the airstreams of ducts or air-handling units shall be insulated with a product with an insulating value of at least 2.0 maximum 'K' value at 75F. Insulation product shall be closed cell, non-toxic, shall be highly resistant to UV light exposure, shall not absorb water or support microbial growth, and shall meet flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723. Insulation product shall remain stable (material shall not degrade, harden or crumble) when operated continuously at temperatures up to 300F.

N. Manufacturers:

1. Dri-Steem
2. Armstrong
3. Pre-approved equivalent

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. General Installation Requirements:

1. Install specialties in accordance with manufacturer's instructions.
2. Coordinate humidifier controls with Siemens prior to ordering equipment.

3.2 HUMIDIFIERS

A. Install components plumb and level, in accordance with approved shop drawings, product installation details and manufacturer's recommendations.

1. Install humidifiers per manufacturers' instructions.
2. Seal humidifier dispersion-tube duct penetrations with flange.
3. Install with required clearance for service and maintenance.

B. Provide humidifiers with complete standalone control system. Control wiring associated with the humidifier and attached sensors is the responsibility of this Contractor.

C. Testing and Adjusting:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Test Results: Reported in writing to the Government.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Training:

1. Engage a factory-authorized service representative to train Government's maintenance personnel to adjust, operate, and maintain humidifiers.
2. Train Government's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
3. Review data in maintenance manual

END OF SECTION 23 84 13

SECTION 26 05 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Description of Systems shall be as follows:

1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
2. Grounding system.
3. Fire alarm system.
4. Wiring of equipment furnished by others.
5. Removal work and/or relocation and reuse of existing systems and equipment.

E. Work Not Included:

1. Telecommunications cabling will be by Division 27, in raceways and conduits furnished and installed as part of the Electrical work.

1.4 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Government, shall be scheduled with the Government. It may be necessary to schedule such work during unoccupied hours. The Government reserves the right to determine when restricted construction hours are required.

B. Itemize all work and list associated hours and pay scale for each item.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination.
b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination.
c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination.
d. Maintenance clearances and code-required dedicated space shall be included.
e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify COR of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to the Government.
3. The contractor shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. Contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.

a. The Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Government.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).
      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the COR for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the COR and the Government's Representative. The COR will only review identified conflicts and give an opinion but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractor will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractor will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The COR reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the COR.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the COR at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the COR and the Government's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Government.

10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the COR any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the COR prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the COR will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the COR are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Peoria, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. If there is a discrepancy between the codes and regulations and these specifications, the COR shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the COR in writing, requesting clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Government.
5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
6. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Government or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Government.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.
8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.
9. Any item listed as furnished shall also be installed unless otherwise noted.
10. Any item listed as installed shall also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractor may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.7 WEB-BASED PROJECT SOFTWARE

A. The Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.

B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.

C. Provide web-based project software user licenses for use by the COR. Access will be provided from the start of the project through the completion of the warranty phase.

D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to COR. Provide data in locked format to prevent further changes.

1.8 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
26 05 73	Power System Study
26 09 33	Lighting Control System
26 24 16	Panelboards
26 24 19	Motor Control
26 27 26	Wiring Devices
26 28 16	Disconnect Switches
26 43 00	Surge Protection Devices
26 51 19	LED Lighting
28 31 00	Fire Alarm and Detection Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
e. Description of items submitted and relevant specification number
f. Notations of deviations from the contract documents
g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

a. Date
b. Project title and number
c. COR
d. Contractors' names and addresses
e. Supplier and manufacturer's names and addresses
f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
g. Description of item submitted (using project nomenclature) and relevant specification number
h. Notations of deviations from the contract documents
i. Other pertinent data
j. Provide space for Contractor's review stamps

3. Composition:

a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:

a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the COR. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
b. Unstamped submittals will be rejected.
c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
b. The Contractor shall clearly indicate the size, finish, material, etc.
c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the COR.
11. Submittals not required by the contract documents may be returned without review.
12. The COR's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the COR to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the COR before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the COR's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and the Government if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of the Government.

    a. Allow at least two weeks for COR's review and processing of each submittal, excluding mailing.

16. COR reserves the right to withhold action on a submittal which, in the COR's opinion, requires coordination with other submittals until related submittals are received. The COR will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the COR, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. Submittal file name: 26 XX XX.description.YYYYMMDD
    b. Transmittal file name: 26 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.9 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Government and COR.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by contractor and major suppliers shall be listed on the Schedule of Values. List each supplier by company name.
2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by COR.
2. Change of supplier occurs.
3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.

B. Itemized pricing with unit cost shall be provided from all distributors and contractor.

C. Change order work shall not proceed until authorized.

1.11 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

1. Distribution equipment - branch panels, distribution panels, switchboards, motor control centers, etc.
2. Transformers, ventilated.

3. Electronic equipment, UPS, harmonic filters, power factor correction.
4. Lighting luminaires and lighting control systems.

C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to the Government that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.

D. Keep all materials clean, dry and free from damaging environments.

E. Coordinate the installation of heavy and large equipment with the Government. If the Contractor does not have prior documented experience in rigging and lifting similar equipment, they shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Government.

B. The following network connected equipment shall be equipped with restricted access protocols:

1. Electrical controls
2. Lighting control system
3. Fire alarm and automatic detection

1.13 WARRANTY

A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the the Government. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Government.

C. Warranty requirements extend to correction, without cost to the Government, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the COR.

1.14 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.

B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The COR shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the COR via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment.

D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. Contractor assumes all costs incurred as a result of using the offered material or equipment.

E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

1.16 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS

2.1 GENERAL

A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the COR, nor the presence of the COR or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The COR and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The COR and the COR's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the COR shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the COR or their representative, and do no further work until the COR or their representative gives further instructions.
9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.
10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the COR.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand and/or CA6 for backfilling.
3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.
4. Dispose of the excess excavated earth as directed.
5. Backfill materials (native soil material, sand, and/or CA6) shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.
9. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.
10. Backfill with native soil material (if approved) or sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.
11. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.
12. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
13. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by COR.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the COR so that the final observation can be scheduled.
3. It is understood that if the COR finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the COR will be deducted from the Contractor's final payment.
4. Contractor shall notify COR 48 hours prior to installation of ceilings or lay-in ceiling tiles.

C. The following must be submitted before COR recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up or reproducible drawings and specifications.
3. A report documenting the instructions given to the Government's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of the Contractor and shall be signed by the Government's representatives.
4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and submit receipt to COR.
5. Inspection and testing report by the fire alarm system manufacturer.
6. Start-up reports on all equipment requiring a factory installation or start-up.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for COR's review and approval. The electronic copy shall be corrected as required to address the COR's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the COR.
2. Approved O&M manuals shall be completed and in the Government's possession prior to the Government's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the COR.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. O&M file name: O&M.div26.contractor.YYYYMMDD
    b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Government with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, COR, Contractor, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include COR's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copies of all factory inspections and/or equipment startup reports.
5. Copies of warranties.
6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
7. Dimensional drawings of equipment.
8. Detailed parts lists with lists of suppliers.
9. Operating procedures for each system.
10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
11. Repair procedures for major components.
12. Replacement parts and service material requirements for each system and the frequency of service required.
13. Instruction books, cards, and manuals furnished with the equipment.

14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.
15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

3.5 INSTRUCTING THE GOVERNMENT'S REPRESENTATIVE

A. Adequately instruct the Government's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Government's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

D. Notify the COR of the time and place for the verbal instructions to be given to the Government's representative so a representative can be present if desired.

E. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.

F. Operating Instructions:

1. Contractor is responsible for all instructions to the Government's representatives for the electrical and specialized systems.
2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Government for the COR to perform these services.

3.6 RECORD DOCUMENTS

A. The following paragraphs supplement Division 1 requirements.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should the Contractor fail to complete Record Documents as required by this contract, the Contractor shall reimburse COR for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the COR's hourly rates in effect at the time of work.

D. Record changes daily and keep the marked drawings available for the COR's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the COR.

F. Record actual routing of conduits exceeding 2 inches.

3.7 PAINTING

A. Paint all equipment that is marred or damaged prior to the Government's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.

C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.

3.8 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Government's final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Government's representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Government's representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.10 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Within the Limits of Construction:

1. The Contractor shall coordinate all work with the contractor responsible for IAQ.
2. The means, methods and materials used by the Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.

B. Outside the Limits of Construction:

1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
2. The Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
3. The Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

3.11 SYSTEM STARTING AND ADJUSTING

A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.

C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.

D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the COR is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Government on a time and materials basis for services rendered at the COR's standard hourly rates in effect when the services are requested. The Contractor shall pay the Government for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.12 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
5. Test cable insulation of panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the COR or authority having jurisdiction deems necessary.

B. Ground-Fault Equipment Performance Testing:

1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:

   a. Fusible switches with ground fault relay protection.
   b. Outside branch circuits and feeders.
   c. Code required.

2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.

C. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

D. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the COR or authority having jurisdiction deem necessary.

E. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.

F. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Government for "benchmark" amperages.

3.13 UTILITY REBATE

A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.

B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Per Section 26 05 00, cable insulation test results have been submitted.
4. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
5. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
6. Report of instruction of the Government's representative has been submitted as per Section 26 05 00.
7. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
8. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the COR so that the final observation can be scheduled.

It is understood that if the COR finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the CORs for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION 26 05 00

SECTION 26 05 05 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.

B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.

C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, the Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.

D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.

E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.

F. Coordinate scope of work with the Government at the project site. Schedule removal of equipment and electrical service to avoid conflicts.

G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

3.2 PREPARATION

A. The Contractor shall obtain approval from the Government before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Government.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.

C. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.

D. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

E. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Government and COR with a Certificate of Destruction to verify proper disposal.

I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.

L. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.

M. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

N. Floor slabs may contain conduit systems. The Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes X-ray or similar non-destructive means. Where conduit is in concrete slab, cut conduit flush with floor, pull out conductors, and plug conduit ends.

O. The Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

END OF SECTION 26 05 05

SECTION 26 05 13 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire

B. Cabling for remote control, signal, and power limited circuits

1.2 RELATED WORK

A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy

B. NFPA 70 - National Electrical Code (NEC)

C. UL 44 - Thermoset-Insulated Wires and Cables

D. UL 83 - Thermoplastic-Insulated Wires and Cables

E. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Feeders and Branch Circuits 8 AWG and larger: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.

B. Feeders and Branch Circuits 8 AWG and larger in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.

C. Feeders and Branch Circuits 10 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings.

D. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.

E. Each 120-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.

1. Fire alarm
2. Low voltage switching and lighting control

B. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Above Accessible Ceilings:

1. Building wire shall be installed in raceway.

B. All Other Locations: Building wire in raceway.

C. Above Grade: All conductors installed above grade shall be type "THHN".

D. Underground or In Slab: All conductors shall be type "THWN".

E. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.

3.2 CONTRACTOR CHANGES

A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)).

B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if they choose to use methods or materials other than the basis of design.

C. Underground electrical duct ampacity rating shall be in accordance with NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.

D. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.

E. Record drawing shall include the calculations and sketches.

3.3 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.

C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.

D. Use no wire smaller than 8 AWG for outdoor lighting circuits.

E. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.

F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

G. Splice only in junction or outlet boxes.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Make conductor lengths for parallel circuits equal.

J. All conductors shall be continuous in conduit from last outlet to their termination.

K. Terminate all spare conductors on terminal blocks, and label the spare conductors.

L. Cables or wires shall not be laid out on the ground before pulling.

M. Cables or wires shall not be dragged over earth or paving.

N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.

P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.4 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.

D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.

E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.

F. Only nylon rope shall be permitted to pull cables into conduit and ducts.

G. Completely and thoroughly swab raceway system before installing conductors.

3.5 WIRING CONNECTIONS AND TERMINATIONS

A. Splice and tap only in accessible junction boxes.

B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.

C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.

D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor. Cold shrink connector insulator with 1kV rating shall be used in damp and wet locations.

F. Thoroughly clean wires before installing lugs and connectors.

G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.

I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:

1. Facing the front and operating side of the equipment, the phase identification shall be:

a. Left to Right - A-B-C
b. Top to Bottom - A-B-C

J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.

C. Inspect wire and cable for physical damage and proper connection.

D. Torque test conductor connections and terminations to manufacturer's recommended values.

E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

F. Provide documentation of the manufacturer's recommended lug torque value for copper conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.

G. Protection of wire and cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

H. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION 26 05 13

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment grounding system

B. Bonding system

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with UL 467 Grounding and Bonding Equipment.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

1.4 SUMMARY

A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.

D. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

E. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Hydraulic compression type, in kit form, and selected per manufacturer's written instructions.

C. Bolted Connectors: Bolted-pressure-type connectors.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.

G. Underground Connections: Exothermic-welded connections. Use for underground connections, except those at test wells.

H. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity. The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.

I. Tighten screws and bolts for grounding and bonding 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.

J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. In raceways, use insulated equipment grounding conductors.

E. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.3 EQUIPMENT GROUNDING SYSTEM

A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.

B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

3.4 BONDING SYSTEM

A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.

B. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.

C. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.

D. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

E. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.

F. Equipment Ground Conductor Continuity: All spliced equipment grounding conductors in junction boxes, cabinets, and distribution equipment shall be connected together and bonded to the metal enclosure.

G. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

H. Metal Poles Supporting Outdoor Lighting Fixtures > 15 feet: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.5 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.6 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION 26 05 26

SECTION 26 05 27 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and Equipment Supports

B. Fastening Hardware

C. Concrete Housekeeping Pads

1.2 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 REFERENCES

A. UL 62275 - Cable Management Systems - Cables Ties for Electrical Installations

1.4 COORDINATION

A. Coordinate size, shape and location of concrete pads with section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Allied Support Systems

B. Cooper B-Line

C. Erico, Inc.

D. Hilti

E. Power Fasteners

F. Orbit Industries

2.2 MATERIAL

A. Support Channel: Hot-dip galvanized for wet/damp locations; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.

B. Hardware: Corrosion resistant.

C. Anchorage and Structural Attachment Components:

1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.

   a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts and Assemblies.
3. Welding Lugs: Comply with MSS-SP-69, Type 57.
4. Beam clamps for Steel Beams and Joists: Double sided or concentric open web joist hangars. Single-sided type is not acceptable.
5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings and matched to the type and size of anchor bolts and studs used.
6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings and matched to the type and size of attachment devices used.
7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

D. Conduit Sleeves and Lintels:

1. Contractor shall provide for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors.
2. Refer to Structural plans and specifications for lintel requirements and sizes.
3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and grouped wall openings shall be approved by the Architect or Structural Engineer.
4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split sleeves are not acceptable. Sleeves through concrete walls may be high density polyethylene pipe penetration sleeve with a water stop collar, suitable for use with Link-Seal mechanical seals. Century-Line Model CS.
5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.
7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
10. Size sleeves large enough to allow expansion and contraction movement.

E. Concrete Housekeeping Pads:

1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings, shall be 3-1/2" thick concrete.
2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).
3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-trap".
4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

F. Rooftop Support System:

1. Provide pre-fabricated roof supports for all conduit and equipment installed above the roof. Support all conduit and equipment a minimum of 4" above roof.
2. Support system shall be compatible with single ply, bituminous, metal, and spray foam roof systems. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.
3. All metal components shall be hot dipped galvanized. Mounting hardware shall be stainless steel or hot dipped galvanized. Support shall be UV, corrosion, and freeze/thaw resistant. Support shall include orange paint, reflective safety orange accents, or similar markings for increased visibility.
4. Products:

    a. Anvil International HBS-Base Series
    b. Cooper B-Line Dura-Blok
    c. Erico Caddy Pyramid 50, 150, 300, or 600 (to match load).

G. Truss and Joist Support System: Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

    a. The hanger is attached within 6" from a web/chord joint.
    b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact COR.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.

B. Trapeze support installation: Cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

D. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.

E. Do not use powder-actuated anchors without specific permission.

F. Do not drill structural steel members.

G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

H. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.

I. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting.

J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

K. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

L. Refer to Section 26 05 33 for special conduit supporting requirements.

3.2 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION 26 05 27

SECTION 26 05 33 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid metallic conduit and fittings (RMC)

B. Electrical metallic tubing and fittings (EMT)

C. Flexible metallic conduit and fittings (FMC)

D. Liquidtight flexible metallic conduit and fittings (LFMC)

E. Rigid polyvinyl chloride conduit and fittings (PVC)

F. Wall and ceiling outlet boxes

G. Electrical connection

H. Pull and junction boxes

I. Accessories

1.2 RELATED WORK

A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

B. Federal Specifications (FS):

1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
2. A-A-55810 - Specification for Flexible Metal Conduit

C. NECA "Standards of Installation"

D. National Electrical Manufacturers Association (NEMA):

1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation

E. NFPA 70 - National Electrical Code (NEC)

F. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 - Flexible Metal Conduit
2. UL 6 - Rigid Metal Conduit
3. UL 360 - Liquid Tight Flexible Steel Conduit
4. UL514-B - Conduit Tubing and Cable Fittings
5. UL746A - Standard for Polymeric Materials - Short Term Property Evaluations
6. UL797 - Electrical Metal Tubing

G. Definitions:

1. Fittings: Conduit connection or coupling.
2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
3. Mechanical Spaces: Enclosed areas usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Manufacturers:

1. Atkore Allied Tube & Conduit
2. Nucor
3. Electroline
4. Western Tube
5. Wheatland Tube Co
6. or approved equal.

B. Manufacturers of RMC Conduit Fittings:

1. ABB/Thomas & Betts
2. Eaton/Crouse-Hinds
3. Electroline
4. Emerson Appleton & OZ Gedney
5. Hubbell Raco and Killark
6. NSI Bridgeport
7. Orbit Industries
8. Wesco Regal
9. or approved equal.

C. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

D. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

E. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system.

1. Acceptable Manufacturers:

a. Atkore Calbond Calpipe
b. Robroy Perma-cote and Plati-Bond
c. ABB Ocal
d. or approved equal.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

B. Manufacturers of EMT Conduit:

1. Allied Tube & Conduit
2. Calbond Calpipe

3. Nucor
4. Electroline
5. Western Tube
6. Wheatland Tube Co
7. or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.
2. Larger than 2": Compression type of steel designed for their specific application.
3. Manufacturers of EMT Conduit Fittings:

a. ABB/Thomas & Betts
b. Eaton/Crouse-Hinds
c. Electroline
d. Emerson Appleton & OZ Gedney
e. Hubbell Raco and Killark
f. NSI Bridgeport
g. Orbit Industries
h. Wesco Regal
i. or approved equal.

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.

B. Manufacturers:

1. ABB/Thomas & Betts
2. Anamet Electrical
3. Atkore American Flex AFC and Flexicon
4. Electri-Flex Co
5. Electroline
6. Southwire Alflex
7. or approved equal.

C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Manufacturers:

    a. ABB/Thomas & Betts
    b. Eaton/Crouse-Hinds
    c. Electroline
    d. Emerson Appleton & OZ Gedney
    e. Hubbell Raco and Killark
    f. NSI Bridgeport
    g. Orbit Industries
    h. Wesco Regal
    i. or approved equal.

2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Manufacturers:

1. ABB/Thomas & Betts
2. Anamet Electrical
3. Atkore American Flex AFC and Flexicon
4. Electri-Flex Co
5. Electroline
6. Southwire Alflex
7. or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
3. Manufacturers:

    a. ABB/Thomas & Betts
    b. Eaton/Crouse-Hinds
    c. Electroline
    d. Emerson Appleton & OZ Gedney
    e. Hubbell Raco and Killark
    f. NSI Bridgeport
    g. Orbit Industries
    h. Wesco Regal
    i. or approved equal.

2.5 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers:

1. ABB/Carlon
2. Chevron Phillips Chemical Company
3. Cantex, J.M. Mfg.
4. Atkore Heritage Plastics
5. or approved equal.

C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.6 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB1, Type FD, Aluminum, cast feralloy, or stainless steel deep type, gasketed cover, threaded hubs.

D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

F. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.7 ECONN; ELECTRICAL CONNECTION

A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.8 JB; PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

E. Flanged type boxes shall be used where installed flush in wall.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING

A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the COR. If the Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.

B. Installation Schedule: Refer to drawings.

C. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.

D. Minimum Conduit Size (Unless Noted Otherwise):

1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
2. Below Grade 5' or less from Building Foundation: 1 inch.
3. Below Grade More than 5' from Building Foundation: 1 inch.
4. Telecommunication Conduit: 1 inch.
5. Controls Conduit: 3/4 inch.

E. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.

B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of COR. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.

C. Conduit arrangement in elevated slabs (restricted to applications specifically noted or shown on drawings):

1. Conduit size shall not exceed one-third of the structural slab thickness. Place conduit between the top and bottom reinforcing with a minimum of 3" concrete cover.
2. Parallel conduits shall be spaced at least 8 inches apart. Exception: Within 18 inches of commonly served floor boxes, junction boxes, or similar floor devices. Arrange conduits parallel or perpendicular to building lines and walls.

D. Conduit shall not share the same cell as structural reinforcement in masonry walls.

E. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.

F. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the COR, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.

3.3 CONDUIT SUPPORT

A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.

1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.

B. Conduit shall <u>not</u> be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the COR. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.

C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.

D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.

F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.

G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.

J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.

K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.

L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.

M. Finish:

1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.4 CONDUIT INSTALLATION

A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.
3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.

B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.

    a. A third bend is acceptable if:

        1) The total run is not longer than (33) feet.
        2) The conduit size is increased to the next trade size.

5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
6. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.

2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.
5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THE CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
7. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system.
8. Do not route conduits across each other in slabs on grade.
9. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.
10. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel conduit shall be installed before conduit exits earth. The conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.
11. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
12. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
13. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
14. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
15. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.

B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.

C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.

D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.

E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the Electrical Code, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.

F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.

G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

3.6 UNDERGROUND CONDUIT INSTALLATION

A. Conduit Connections:

1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.

B. Conduit Bends (Lateral):

1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.
2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with COR prior to conduit installation to determine bend radius.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (greater than 600V) and 18 inches for secondary conduits (less than 600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Expansion Fittings at Finished Grade: Provide underground raceways with an expansion fitting after emerging from finished grade and exterior equipment pads. Field locate the expansion fitting above and within 24 inches of finished grade. Raceways extending less than 12 inches above finished grade, transitioning to LFMC within 12 inches of finished grade, and interior concrete building slabs do not require an expansion fitting unless required by code.

E. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.

2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
4. Before the Contractor pulls any cables into the conduit, Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
8. All non-metallic conduit installed underground outside of a slab shall be rigid.

F. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

G. Raceway Seal (Exterior to Raceway):

1. All power, telecommunication, electrical conduits and innerducts shall be sealed between the raceway and the building foundation. The raceway penetration shall be sealed liquid-tight, water-tight, non-corrosive.

2. Below Grade Installation Options:

   a. Cast-in-place concrete installation.
   b. Hydraulic cement, hydraulic group, hydraulic epoxy.
   c. Foundation - Underground Sleeves and Seals; refer to Part 2-Products for product information.

3. Above Grade Installation Options:

   a. Masonry grout for masonry applications.
   b. Caulk Sealant, interior/exterior rated, color per architect. Refer to architectural specifications for additional requirements.

H. Raceway Seal (Interior to Raceway, with Cables or Empty):

1. All power, telecommunication, electrical conduits and innerducts, including those with cables, shall be sealed at the building and vault entry. The seal shall prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceways shall also be sealed.

2. Installation Schedule, nominal size:

    a. 2" or less: Duct Seal Bushing or Duct Sealnt
    b. 2-1/2" through 4": Duct Seal Bushing
    c. 5" and 6": Wall Sleeve Duct Seal System

3.7 BOX INSTALLATION SCHEDULE

A. Galvanized steel boxes may be used in:

1. Concealed interior locations above ceilings and in hollow studded partitions.
2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
3. Direct contact with concrete except slab on grade.

B. Cast boxes shall be used in:

1. Exterior locations.
2. Exposed interior locations within 8' of the highest platform level.
3. Direct contact with earth.
4. Direct contact with concrete in slab on grade.
5. Wet locations.

3.8 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the COR.

D. Locate and install to maintain headroom and to present a neat appearance.

3.9 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)

D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.

E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

F. Provide knockout closures for unused openings.

G. Support boxes independently of conduit.

H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

I. Install boxes in walls without damaging wall insulation.

J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.

K. Position outlets to locate luminaires as shown on reflected ceiling drawings.

L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

N. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.10 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.11 EXPOSED BOX INSTALLATION

A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.

B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.

C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.

D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.

E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)

F. Wood, plastic, or fiber plugs shall not be used for fastenings.

G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION 26 05 33

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Adhesive Markings and Field Labels

B. Nameplates and Signs

C. Product Colors

1.2 RELATED SECTIONS AND WORK

A. Section 26 05 00 - Basic Electrical Requirements

1.3 REFERENCES

A. NFPA 70E - Standard for Electrical Safety in the Workplace

B. NFPA 70 - National Electrical Code (NEC)

C. ANSI A13.1 - Standard for Pipe Identification

D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

1.4 QUALITY ASSURANCE

A. Electrical identification products shall be suitable for the environment installed. Identification labels damaged by the environment due to ultraviolet light fading, damp or wet conditions, physical damage, corrosion, or other conditions shall be replaced with labels suitable for the environment.

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

A. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

B. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

D. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from -40°F to 185°F (-40°C to 85°C), type 2/2S or type 21/21S based on application. Provide ties in specified colors when used for color coding. Cable ties shall be listed and identified for the application, securement, and support.

E. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

F. Aluminum, Wraparound Marker Bands: 1-inch width, 0.014 (5mm) inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Brass or Aluminum Tags: 2" (50mm) by 2" (50mm) by .05-inch metal tags with stamped legend, punched for fastener.

H. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

I. Text Sizes:

1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.

a. Font: Normal 721 Swiss Bold
b. Adhesive Labels: 3/16 inch minimum text height
c. Vinyl / Plastic Laminate Labels: 3/4" inch minimum text height

2.2 NAMEPLATES AND SIGNS

A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.

B. Text Sizes:

1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.

a. Text Height: 3/8 inch minimum

C. Baked-Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting 1/4" grommets in corners.

E. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

F. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

2.3 PRODUCT COLORS

A. Adhesive Markings and Field Labels:

1. All Labels: Black letters on white face
2. Normal Power and General Labels: Black letters on white face
3. Control Labels: Black letters on white face
4. Fire Alarm: Red letters on white face
5. Emergency: Red letters on white face

B. Nameplates and Signs:

1. NORMAL POWER: Black letters on white face
2. Control Labels: Black letters on white face
3. EMERGENCY: White letters on red face
4. GROUNDING: White letters on green face.
5. CAUTION or UPS: Black letters on yellow face

C. Raceways and Conduit:

1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:

a. Normal Power and General Distribution: Silver
b. Emergency Power Distribution System:

1) All Emergency: Orange

c. Fire Alarm System: Red
d. Temperature Controls: Refer to mechanical cover sheet for color
e. Ground: Green

D. Box Covers:

1. Box cover colors shall match conduit colors listed above.

E. Conductor Color Identification: Refer to Part 3 for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.

B. Exposed Ceilings and Finished Spaces: The project includes exposed ceilings in finished spaces. The installation of colored raceways and labeling may not be aesthetically desirable in finished spaces. The contractor shall coordinate identification requirements in exposed ceilings of finished spaces with the COR prior to installation and ordering of materials.

C. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

E. Circuit Identification: Tag or label conductors as follows:

1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

F. Apply Danger, Warning, Caution and instruction signs as follows:

1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.
3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.
5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.

H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

I. Install ARC FLASH WARNING signs on all power distribution equipment per Section 26 05 73.

J. Selective Coordination Label: Install caution signs on all switchboards, distribution panels, panelboards, disconnects, and other equipment with selectively coordinated overcurrent protection devices. Sign at a minimum shall contain:

1. CAUTION: OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED. EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED.

K. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

3.2 FEEDER AND BRANCH CIRCUIT DIRECTORIES

A. Product:

1. Adhesive labels and field markings
2. Nameplates and signs

B. Feeder Directories Branch: Provide each feeder, branch circuit, feeder modification, and branch circuit modification with a typed circuit directory label. Refer to technical equipment specification sections for additional requirements. Include the following with each label:

1. Load Description: Lighting, receptacles, specific equipment, spare, space, or similar description.
2. Location: Room name, number, location.

C. Provide a factory or custom clear plastic sleeve for each branch panel directory and secure to inside panel cover.

3.3 LIGHTING CONTROL AND RECEPTACLE COVER PLATES

A. Product:

1. Adhesive labels and field markings
2. Nameplates and signs

B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.

C. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (e.g. "C1A #24"). Identification for switch cover plates shall be installed on the inside cover.

3.4 BOX LABELING

A. Products:

1. Adhesive labels and field markings

B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape OR Brother self-laminating vinyl label, letters/numbers color coded same as conduits. In rooms that are painted out, provide labeling on inside of cover.

C. All junction, pull, and connection boxes shall be identified as follows:

1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").
2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").

3.5 CONDUCTOR COLOR CODING

A. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

B. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

C. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.

D. Conductors shall be color coded as follows:

1. 208Y/120 Volt, 4-Wire:

a. A-Phase - Black
b. B-Phase - Red
c. C-Phase - Blue
d. Neutral - White
e. Ground Bond - Green

2. 480Y/277 Volt, 4-Wire:

a. A-Phase - Brown
b. B-Phase - Orange
c. C-Phase - Yellow
d. Neutral - Gray
e. Ground Bond - Green

3. Grounding Conductors:

a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.

4. Cabling for Remote Control, Signal, and Power Limited Circuits:

   a. Fire Alarm: Refer to Fire Alarm and Automatic Detection Section 28 31 00 for cable color requirements.
   b. Low Voltage Switching: Per manufacturer recommendations and code requirements.
   c. Building Automation Systems and Control: Refer to the Temperature Control Contactor notes located on the mechanical cover sheet.

3.6 CONTROL EQUIPMENT IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification on the front of all control equipment such as combination starters, starters, VFDs, contactors, motor control centers, etc.

C. Identification shall be provided for all connections to equipment furnished by the Contractor or the Government.

D. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served.
2. Location of equipment being served if it is not located within sight.
3. Voltage and phase of circuit(s).
4. Panel and circuit number(s) serving the equipment.
5. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
6. Date of fault current study, refer to one-line diagram
7. Sample Label:

   EXHAUST FAN EF-1 ("LOCATED ON ROOF")
   480V, 3-PHASE
   FED FROM "1HA1-1"
   AUTO CONTROL BY FMCS
   22,000 AMPS AVAILABLE FAULT CURRENT
   DATE OF STUDY: 1 JAN 2017

3.7 EQUIPMENT CONNECTION IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.

C. Identification shall be provided for all connections to equipment furnished by the Contractor or the Government. The following list of equipment is specifically being listed to receive an equipment connection label; this list does not limit the equipment that shall receive a label:

1. Mechanical heating, ventilation, and air conditioning equipment; chillers, boilers, pumps, air handling ventilation units, condensing units, unit heaters, and similar equipment
2. Plumbing equipment

D. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served
2. Location of equipment being served if it is not located within sight.
3. Voltage and rating of the equipment.
4. Panel and circuit numbers(s) serving the equipment
5. Available fault current
6. Date of fault current study
7. Sample Label:

UNIT HEATER UH-1 ("LOCATED IN STORAGE ROOM 200")
480V: 3-PHASE
FED FROM "1HA1-1"
22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

3.8 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards, switchgear, motor control centers, generators, UPS, storage battery disconnects, transfer switches, etc. Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and identify each cubicle of multi-section gear.

1. Interior Equipment: The identification material shall be engraved plastic-laminated labels.
2. Exterior Equipment: The identification material shall be engraved vinyl labels.
3. Labeling shall include:

a. Equipment type and contract documents designation of equipment.
b. Voltage of the equipment.
c. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
d. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").
e. Sample Label:

DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELEC ROOM)

4. Provide the following on a separate label, installed below the label above:

   a. Available fault current; refer to one-line diagram or panel schedules
   b. Date of fault current study; refer to one-line diagram
   c. Sample Label:

      22,000 AMPS AVAILABLE FAULT CURRENT
      DATE OF STUDY: 1 JAN 2017

C. Adjustable-Trip Over Current Protection Label:

1. Provide a separate engraved plastic laminate label adjacent to each overcurrent projection device with adjustable trip settings. Provide label separate from load identification label.

   a. Label:

      1) Long-time delay:
      2) Long-time pickup:
      3) Short-time delay:
      4) Short-time pickup:
      5) Instantaneous:
      6) Ground fault delay:
      7) Ground fault:

   b. Sample Label:

      Long-time delay: 10.0
      Long-time pickup: 1.0
      Short-time delay: 0.15
      Short-time pickup: 5.0
      Instantaneous: 2.0
      Ground fault delay: 0.25
      Ground fault: 50.0

D. Nominal System Voltage Label:

1. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used in the panelboard or equipment shall be permanently posted on the interior of the door or cover.

E. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1"). Provide a separate engraved plastic laminate label adjacent to each overcurrent projection device with feeder wire size, feeder wire quantity, conductor material and distance in feet. Provide label separate from load identification label and adjustable trip settings label.

1. Sample Labels for Feeders:

   4#3/0 CU & 1#6 CU GND, 125FT
   4#250KCM AL & 1#6 GND CU, 125FT
   2 SETS 4#400KCM CU & 1#1 GND CU, 125FT

F. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

3.9 TRANSFORMER EQUIPMENT IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification on the front of all transformers. The identification nameplate shall be an engraved plastic-laminated label.

C. Labeling shall include:

1. Equipment type and contract documents designation of equipment
2. Name of the upstream equipment.
3. Voltage and rating of the equipment.
4. Location of the upstream equipment if it is not located within sight.
5. Sample Label:

TRANSFORMER TR-15
480V: 208Y/120V 15KVA
FED FROM SWITCHBOARD "SB-1" (LOCATED IN ELEC 123)

3.10 ELECTRICAL WORKING CLEARANCE IDENTIFICATION

A. Products:

1. Safety Yellow paint and custom stencils

B. Provide custom identification of electrical equipment working clearances in mechanical, electrical, storage, janitorial, and similar non-public areas.

C. Identification shall include a painted rectangular box (on the finished floor) in front of the electrical equipment to define the code-required working clearance. Provide additional diagonal stripping inside the rectangle box. All painted stripping shall be safety yellow paint with 3 inch wide stripes.

1. Width of area: Width of equipment or as required by code
2. Depth of area: Depth as required by code

3.11 POLE IDENTIFICATION

A. Product:

1. Adhesive labels and field markings
2. Nameplates and signs

B. Lighting poles, bollards and overhead distribution poles shall be individually identified with a unique number, for maintenance purposes. Apply the vinyl label number above the hand hole cover or 24" (610mm) above grade. Bollards may be identified with a number applied inside the luminaire that is visible from the exterior.

END OF SECTION 26 05 53

SECTION 26 05 73 - POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low voltage distribution system power study.

B. Short-circuit analysis and report.

C. Selective coordination analysis and report.

1.2 RELATED SECTIONS

A. Section 26 05 00 - Basic Electrical Requirements

B. Section 26 24 16 - Panelboards

1.3 SUBMITTALS

A. Documentation shall bear the seal/signature of the licensed Professional Engineer who performed the analysis.

B. The input for the power system study shall be based on the contract documents, with estimated conductor lengths and field investigation of existing equipment types, sizes, ratings provided by the Contractor.

C. Documentation of the analyses shall be submitted in a single bound electronic (PDF or equal) format and shall accompany the shop drawing submittals for equipment provided under the related work specification sections. The submittal of these related specification sections will not be reviewed without this documentation. Submit a sample arc-flash hazard label for Government review and approval prior to printing.

D. Power system study project model shall be submitted on electronic media for review and the Government's operating and maintenance records.

1.4 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

B. NFPA 70E - Standard for Electrical Safety in the Workplace

C. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations, latest version

D. ANSI Z535.4 - Products Safety Signs and Labels

1.5 SCOPE

A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, coordination analysis.

B. Contractor is required to provide a fully coordinated system for the normal electrical system or emergency electrical system and all other locations indicated on the one-line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a coordinated system.

PART 2 - PRODUCTS

2.1 POWER SYSTEM STUDY

A. Power systems study shall be completed in Power Tools for Windows (PTW) version 11 or pre-approved equivalent program.

B. Power system studies including, but not limited to short-circuit analysis, selective coordination, and arc-flash analysis are inherently iterative in nature. The initial and subsequent analysis commonly requires engineering evaluation, equipment modification, setting adjustments, and revised analysis report. The power system analysis scope shall not be considered complete until all outstanding engineering, equipment and device setting solutions have been resolved and documented by a final report. The power system study vendor shall provide inclusive bid provisions for the initial, subsequent, final analysis and associated reports.

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS

A. Provide a complete short-circuit analysis from the utility service to and including the entire Vault 5 distribution as shown on the drawings.

B. Analysis shall include the entire distribution system from the point of connection to the utility power source to the distribution panels and branch circuit panelboards.

3.2 COORDINATION ANALYSIS

A. Provide a complete selective coordination analysis comparing time/current curves of the protective devices to be installed to assure coordination between main and downstream devices. Overcurrent protection devices shall be coordinated based on the maximum available fault current results of the short-circuit analysis report.

B. Existing Distribution, Selective Coordination, and Analysis:

1. The scope of work includes modification, replacement, adjustments, or additions of the emergency distribution system. A complete analysis and evaluation of the existing Emergency and Legally required branches is required in addition to the evaluation and analysis of the new distribution system components.
2. The contractor shall provide field investigation service to collect all pertinent information required for a complete analysis and evaluation including but not limited to:

    a. Over Current Protection Device (OCPD): Manufacturer, model, ratings, and settings
    b. Feeder and Branch Circuit Conductor: Wire gauge sizes, lengths, and material type
    c. Transformers: Manufacturer, model, transformer KVA, impedance, phase, voltage, configuration
    d. Transfer Switch: Manufacturer, model, transfer switch voltage, amp rating, 3 or 4 pole configurations, switch style, short circuit withstand current rating
    e. Emergency Power Supply: Manufacturer, model, power source type, voltage, amperage, ratings, fault current contribution values
    f. Existing Distribution System Documentation: One line or riser diagram relationship of all distribution equipment including switchboards, switchgear, distribution panels, branch panelboards, transformers, transfer switches, emergency power supply, all line side normal and emergency power systems serving the applicable branches from the main electrical service and emergency power supply to the final branch circuit over current protection device.

C. Provide trip settings for all (selectively coordinated and non-selectively coordinated) adjustable trip over current protection devices including long time delay, long time pickup, short time delay, short time pickup, instantaneous and ground fault. Selectively coordinated branches shall be based on the selective coordination study results. Non-selective coordinated branches shall be based on the design trip ratings. Provide selective coordination between all ground fault trip settings.

D. The analysis shall include primary protective device, secondary main switchboard/switchgear device(s), switchboard/switchgear branch feeder devices, generator breaker, distribution panel, panelboard main devices, and branch feeder devices.

E. The analysis shall include all normal, legally required, and optional standby overcurrent protection devices served by the same electrical bus and directly in parallel with the emergency branch requiring selective coordination.

F. The coordination plots provided shall indicate graphically the coordination proposed for the system on full-size log forms and shall define the types of protective devices selected, together with proposed time dial and pickup settings required. The plots shall include titles, representative one-line diagrams, legend, complete parameters for transformer(s), and complete operating bands for circuit breaker trip devices, fuses, etc.

1. The long-time region of the coordination plots shall designate the pickups required for the circuit breakers.
2. The short-time region shall indicate the magnetizing in-rush and ASA-withstand-transformer parameter, the circuit breaker, short-time and instantaneous trip devices, fuse-manufacturing tolerance bands, significant symmetrical fault currents, etc.
3. The protective device characteristics or operating bands shall be suitably indicated to reflect the actual symmetrical fault currents sensed by the device.

4. The drawings and specifications indicate the general requirements for motors, motor-starting equipment, and medium-voltage and low-voltage equipment, but additional specific requirements of equipment furnished shall be determined in accordance with the results of the coordination study.

    a. The study shall include verification of equipment ratings and settings. The Contractor shall keep the study up-to-date with any project changes which affect the study and submit the revised study for review. A final electronic copy shall be submitted with the record drawings.

G. Provide summary table of adjustable overcurrent protective devices settings for the operating and maintenance manual.

3.3 ADJUSTMENTS

A. Manufacturer's authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study. Apply settings prior to placing equipment into operation. When the scope of work or execution includes remodel or phases construction, the contractor shall adjust applicable settings as required prior to each system component placed in operation.

END OF SECTION 26 05 73

SECTION 26 09 33 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting Control Overview

B. Electrical Plan Symbols

C. Device Color and Coverplates

D. Standalone Line and Low Voltage Lighting Controls

1. Wall switches and wall dimmers
2. Sensors (occupancy, vacancy, daylighting, photocell, auxiliary power packs, etc.)

E. Room-Based Lighting Controls (specification grade, commonly distributed controllers, occasionally networked, 'intelligent' controls)

F. Network-Based Lighting Controls (specification architectural grade, networked, intelligent, commonly centralized and/or distributed components)

G. Automatic Load Control Relays

1. Automatic Load Control Relay (ALCR20)

1.2 RELATED SECTIONS

A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of directly comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:

1. Specification Section 26 24 16 Panelboards (panelboard enclosure and interior bussing used for lighting control panels)
2. Specification Section 26 51 19 LED Lighting
3. Electrical Drawings: Electrical Coversheet, plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 QUALITY ASSURANCE

A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. All components and assemblies are to be factory pre-tested prior to delivery and installation.

1.4 REFERENCES

A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference

B. FS W S 896 Switch, Toggle

C. NEMA WD 1 - General Color Requirements for Wiring Devices

D. NEMA WD 7 - Occupancy Motion Sensors

E. NFPA 70 - National Electrical Code (NEC)

F. UL Standard 916 Energy Management Equipment

G. UL 924 - Emergency Lighting and Power Equipment

H. UL 20 - Standards for General-Use Snap Switches

I. UL 98 - Enclosed and Dead-Front Switches

J. UL 917 - Clock Operated Switches

K. UL 1008 - Transfer Switch Equipment

L. UL 1472 - Solid-State Dimming Controls

1.5 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, component replacement instructions, warranty, system software requirements.

C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form. Sensor coverage patterns shall have a 20% overlap.

D. Submit a list of devices and equipment that will be installed for each sequence of operation.

E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, dimmers, relays, low voltage switches, automatic sensors, control stations, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.

F. Programming Sequences: Provide a copy of the initial lighting control programming sequences in narrative and manufacturer/vendor format.

G. Lighting Control Stations: The manufacturer/vendor shall provide control station shop drawings showing arrangement of controls, dimensioned elevations, wiring diagram, and recommended backboxes. Label each applicable submittal with the applicable Sequence Of Operation SOO description. Submit data sheets on the switches, dimmers, sensors, buttons, etc. contained in the control station.

H. Nameplate Labels and Custom Engraving: Submit sample label/engraving text for review for each applicable Lighting Sequence Of Operation SOO. Include reference to applicable SOO description. Provide stencil templates for each device requiring stenciling.

1.6 EXTRA STOCK

A. Provide extra stock under provisions of Section 26 05 00.

B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.

C. Control Stations: One (1) of each configuration and type, except for LCD (SW-LDC) touch screens and portable PCS (SW-PCS) control stations requiring factory setup prior to installation.

1.7 PROJECT RECORD DOCUMENTS

A. Submit project record documents under provisions of Section 26 05 00.

B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:

1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
3. Replacement part numbers for all system components.

B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.

C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

1.9 SYSTEM DESCRIPTION

A. Performance Statement: The specification section and lighting design documents describe the minimum material quality, required features, and operational performance requirements of the lighting control system. The documents do not convey every component, relay, wire, and equipment connection required. The Contractor and lighting control manufacturer/vendor are solely responsible for determining all system components, wiring, and programming required for a complete and operational system based on the performance based requirements of the documents.

B. Lighting Sequence Of Operation (SOO): The Sequence Of Operation (SOO) describes the required lighting control operation and performance in each space. The Sequence Of Operation descriptions are included on the drawings.

C. Drawings: The drawings include the Sequence Of Operation (SOO), luminaire schedule, location of control devices, sensors, and identification of control zones, and branch power circuiting. Control wiring and manufacturer/vendor specific components are NOT shown, but shall be submitted with the shop drawing submittals.

1.10 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.

B. Automatic (occupancy, vacancy), daylight sensors, and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL OVERVIEW

A. Lighting Control System: As defined in the System Description, the design documents describe the operational performance requirements of the lighting control system. The Lighting Control System has been categorized into the following groups. Refer to the Electrical Symbol Key, this specification section, and the drawings to determine the appropriate lighting control category when more than one is applicable to the project:

1. Standalone Lighting Control Devices: Independent (standalone) devices traditionally operating at line or low voltage, field configurable with other standalone devices to provide an overall lighting control system.
2. Room-Based Lighting Controls: Integrated system comprised of switch stations, sensors, room controllers, control panels, and accessories, operating at line and/or low voltage, configured as an integrated overall 'intelligent' lighting control system. Lighting control zones and power circuits commonly align.

3. Network-Based Lighting Controls: Integrated system comprised of switch stations, sensors, room controls, control panels, dimmer racks, and accessories, operating at line and/or low voltage, configures as an integrated overall 'intelligent' lighting control system for advanced architecturally based lighting control systems. Lighting control zones commonly associated with one or more branch power circuits within the same control zone.

B. All system components and materials of similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications. Lighting control switches, systems, and components shall be listed.

C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space, unless otherwise noted.

D. Emergency Lighting Override Control (UL924 and UL1008): Lighting Control Equipment coupled with remote emergency power sources (external to the luminaire) require ALCR (UL924) or BCELTS (UL1008) devices for emergency (life safety) compliance. An emergency lighting control bypass is required for every individual lighting control zone-circuit but NOT shown on the plans. Refer to this specification for ALCR and BCELTS descriptions. Refer to the sequence of operation lighting control descriptions on the plans for additional requirements. (For additional explanation purposes: Integral emergency power sources like battery drivers inside the luminaire are commonly provided with a switch and non-switched portion of the circuit allowing compliance without an ALCR nor BCELTS device to bypass the lighting controls).

2.2 ELECTRICAL PLAN SYMBOLS

A. Refer to Electrical Coversheet for Electrical Symbols list and device specification tag.

1. Standalone Lighting Control Devices: Control station commonly defined by an alpha character with subscripts.

   a. Example symbol "S", tagged "SW-1P", description "switch- single pole switch".
   b. Example Control Designation: a, b, c (when required to clarify design intent).

2. Room-Based Lighting Controls: Control station commonly defined by a rectangle symbol.

   a. Example Control Station: symbol "#B", tagged "SW-LV", description "Lighting Control Station".
   b. Example Panel/Rack/Cabinet: tagged "LCPR#", description Room-Based lighting control panel/rack/cabinet.
   c. Example Control Designations: a, b, c

3. Network-Based Lighting Controls: Control station commonly defined by a rectangle symbol.

   a. Example symbol "#B", tagged "SW-#B", description "Lighting Control Station".
   b. Example Panel/Rack/Cabinet: tagged "LCPN", description "Network- Based lighting control panel/rack/cabinet".
   c. Example Control Designations: z1, z2, z3

4. Sensors, Relays, Accessories: Common plan symbols are used for automatic (occupancy, vacancy), and daylighting sensors. The control designations (a, b, c or z1, z2, z3) and identification of a standalone or #B type control station in the space defines the basis-of-design intent category of the lighting control sensors and accessories.

    a. Example, a standalone automatic sensor SW-OC-## or SW-VC-## device is the basis of design when shown in the same room as a standalone S (SW-1P) single pole light switch with or without a, b, c control designations.
    b. Example, a Room-Based Lighting automatic sensor SW-OC-## or SW-VC-## device is the basis of design when shown in the same room as a #B (SW-#B) lighting control station with or without a, b, c control designations.
    c. Example, a Network-Based Lighting automatic sensor SW-OC-## or SW-VC-## device is the basis of design when shown in the same room as a #B (SW-#B) lighting control station with z1, z2, z3 control designations.

2.3 DEVICE COLOR AND COVERPLATES

A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space. When the coverplate is proprietary to the device/manufacturer and do not match the wiring device coverplates, the architect shall select the coverplate color and materials from the standard coverplate options.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate-securing screws shall be metal with head color matching the wall plate finish.

2.4 STANDALONE LINE AND LOW VOLTAGE LIGHTING CONTROLS

A. Standalone Lighting Control System Description: The standalone lighting control system includes individual devices, components, and accessories for lighting controls.

B. The lighting control system manufacturer shall be responsible to assure coordination and compatibility between all system devices, components, and accessories.

C. Global System Typography: The system shall be provided with the following global system characteristics. When multiple exclusive options are listed the manufacturer/vendor may submit a system based on either criterion unless otherwise noted. When the drawings identify a specific option (typically identified with a subscript) provide the specific option as scheduled on the drawings.

1. Automatic Sensor Control Devices, Component, and Accessories: Field adjustable Occupancy or Vacancy.

D. Overview:

1. Wall Switches and Wall Dimmers:

   a. UL listed with integral air-gap switch for on/off control, integral EMI/RFI suppression, non-viewable heat sink, dimmer to match device color.
   b. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.

E. **SW-1P**; Single Pole Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
2. Manufacturers:

   a. Hubbell HBL1221
   b. Leviton 1221-2
   c. Pass & Seymour PS20AC1
   d. Cooper AH1221

F. **SW-3W;** Three-way Switch:

1. Single throw, 120/277 volt, 20 amp. Toggle handle, side and back wired.
2. Manufacturers:

   a. Hubbell 1223
   b. Leviton 1223-2
   c. Pass & Seymour PS20AC3
   d. Cooper AH1223

3. Single throw, 120/277-volt, 20-amp maintained contact. Rocker handle, side and back wired.
4. Manufacturers:

   a. Hubbell DS320
   b. Leviton 5623
   c. Pass & Seymour 2623
   d. Cooper 7623

G. **SW-O;** Dual Technology Automatic Sensor with Wall Switch (Standalone):

1. Wall switch with manual on/auto/off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 20-minute adjustable OFF delay. Dual technology ultrasonic/acoustic and PIR coverage of minor motion in 12' x 15' pattern and occupancy detection in area based on half-step walking motion. Sensitivity adjustments separate for each sensing technology.
2. Manufacturers:

   a. Watt Stopper DW-100 Series
   b. Hubbell LHMTS
   c. Leviton ODSMT Series
   d. Sensor Switch WSX-PDT SA Series (acoustic approved when listed in above description)

H. **SW-LS;** Daylight Level Sensor and Controller (Standalone):

1. Contractor / vendor to provide daylight sensor based on sequence of operation requirements. Verify compatibility with luminaire shop drawings and luminaire driver prior to lighting control prior to purchase and installation.
2. Subscripts: Subscripts are used to define the device type:

    a. (BLANK) = Dimming Control
    b. S = Switched Control
    c. W = Wireless w/ Battery
    d. # = Special Function

3. Daylight level sensor, 120/277 volt, one or multi-zone per application, on/off/0-10 volt dimming control per application, 10-200 footcandle sensor range, adjustable deadband to prevent cycling and 0-30 minute adjustable time delay. Initial Settings: Refer to Sequence of Operation.
4. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area based on sequence of operation.
5. Sensor shall be configurable via DIP switches at device or via handheld wireless remote programming unit. Settings shall include:

    a. Ambient sensitivity range between 10-200 foot-candles.
    b. Time delay of 5 to 300 seconds.
    c. Trigger setpoints with deadband adjustment.

6. Sensor shall provide on/off setpoints in quantity as specified on drawings and as shown in the sequence of operation.
7. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application requirements as outlined in the sequence of operation.
8. Output signal from sensor shall be linear with light level.

9. Manufacturers:

    a. Watt Stopper LS-301 (dimming one zone)
    b. Sensor Switch N-CMADC (dimming one zone)
    c. Hubbell Automation DLC7 (dimming one zone)
    d. Watt Stopper LCD-203/LS-290C (dimming three zone)
    e. Sensor Switch N-CMADC (dimming three zone)
    f. Hubbell Automation LUXSTATDCM/LUXSTATLS (dimming three zone)
    g. LC&D Micro GR/2404 IDIM/Pcell (dimming three zone)
    h. Watt Stopper LS-102 (on/off one zone)
    i. Sensor Switch CM-PC (on/off one zone)
    j. Hubbell Automation DLCPC Series (on/off one zone)
    k. Watt Stopper LCO-203/LS-290C (on/off three zone)
    l. Sensor Switch N-CMPC (on/off three zone)
    m. Hubbell Automation LUXSTATOCM/LUXSTATLS (on/off three zone)
    n. LC&D Micro GR/2404 iDH/Pcell (on/off three zone)

I. **SW-LS-PC;** Exterior Photo Sensors (Standalone):

1. Contractor / vendor to provide sensor based on sequence of operation requirements. Verify compatibility with lighting control system prior to purchase and installation.

2. Subscripts: Subscripts are used to define the device type:

    a. (BLANK) = Standalone Device
    b. #R = Room-Based Lighting Control Device
    c. #N = Network-Based Lighting Control Device

3. Exterior photocell sensor, 120/277 volt, 1800 VA minimum standard SPST formed contact zero-crossing closure, ambient sensor range 5 - 1,500 foot-candles, adjustable setpoint, adjustable deadband, adjustable time delay, weatherproof enclosure with threaded base for box installation and toolless twist-lock removable/replaceable photo eye assembly, -30°F to +130°F operation. Provide with lens cover that can be applied for system testing during daylight conditions.
4. Installation: Mount sensor to face North-East.
5. Manufacturers Standalone:

    a. Paragon Twistlock Series
    b. Tork Turnlock Series
    c. Intermatic LC4546 Series

6. Manufacturers Room-Based or Network-Based:

    a. Manufacturer of Room-Based or Network-Based system.

J. **SW-OC-# and SW-VC-#;** Automatic Sensors (Standalone):

1. Combination Devices: Subscripts identify combination type devices when applicable. The contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device. Manufacturer verified layouts shall include a 20% overlap of coverage patterns.
2. Subscripts: Subscripts are used to define the device type.

    a. Blank (or D) = Dual Technology
    b. A = Ultrasonic two-sided corridor coverage
    c. P = Passive infrared
    d. P2 = Passive infrared 100 degree coverage
    e. U = Ultrasonic 360 degree coverage
    f. HA = Highbay aisle coverage
    g. HB = Highbay
    h. W = Wireless with battery, 10 year minimum

3. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

    a. Operation - Occupancy: Occupancy sensors turn lights 'on' when covered area is occupied and turn lights 'off' with a time delay when unoccupied, unless otherwise indicated.
    b. Operation - Vacancy: Vacancy sensors require a manual switch operation to turn lights 'on' with a time delay when occupied to turn lights 'off'.
    c. Time Delay 'Off': Field adjustable with a minimum range of 1-20 minutes.
    d. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

e. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13-amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by Electrical Code.

f. Mounting:

1) Sensor: Suitable for mounting in any position on a standard outlet box.
2) Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.
3) Time Delay and Sensitivity Adjustments: Recessed and concealed.

4. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.
5. Bypass Switch: Override the on function in case of sensor failure.
6. Power Supply and Child Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
7. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
8. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

a. **Blank (or D);** Dual Technology 360 Degree Coverage Automatic Sensor: Combination of PIR and ultrasonic or acoustic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact. Sensor shall control all circuits in area, unless noted otherwise.

1) Manufacturers:

a) Watt Stopper DT 300/200 Series
b) Hubbell OMNI-DT2000 / LODTRP / ATD2000C Series
c) Leviton OSC-MOW / OSM12 Series
d) Sensor Switch CM PDT 10 / WvpDT 16 series (acoustic)

b. **(P);** Passive Infrared, 360 Degree Coverage Pattern Ceiling Mount Automatic Sensor: Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise.

1) Manufacturers:

a) Watt Stopper CI Series
b) Sensor Switch CM-9
c) Hubbell Automation Omni-IR
d) Leviton OSC Series
e) Cooper OAC-P Series

c. **(U);** Ultrasonic 360 Degree Coverage, Ceiling Mounted, Automatic Sensor: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage. 20' x 20' Hand Motion Coverage Pattern. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated 1-amp relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

1) Manufacturers:

a) Watt Stopper WT-1100 Series
b) Hubbell OMNI-US or ATU Series
c) Leviton OSC Series
d) Cooper OAC-U Series

2.5 ROOM-BASED LIGHTING CONTROL SYSTEM ('INTELLIGENT CONTROLS)

A. Manufacturers: Manufacturers as listed below meet the qualifications as outlined in this specification. Contractor is responsible for verifying that selected manufacturer is capable of furnishing the complete system as specified herein.

1. Acuity Controls nLight Series
2. Current Automation NX Series
3. Legrand Watt Stopper DLM Series
4. Lutron

B. Room-Based Lighting Control System Description: The room-based lighting control system is a distributed network of devices, components, and accessories for lighting controls and integrated control with other systems. The system includes system room controllers (network hubs), control stations, sensors (occupancy, vacancy, daylighting, etc.), switching/dimming modules, programming, 365/7 day scheduling, and associated wiring.

C. The lighting control system manufacturer shall be responsible to assure coordination and network compatibility between all system devices, components, and accessories.

D. Global System Typography: The system shall be provided with the following global system characteristics. When multiple exclusive options are listed the manufacturer/vendor may submit a system based on either criterion unless otherwise noted. When the drawings identify a specific option (typically identified with a subscript) provide the specific option as scheduled on the drawings. (Example, a control station (SW-#B) shown with a "W" subscript on the plans shall be provided in a wireless configuration regardless if the following specification descriptions allow both low voltage or wireless network.)

1. System Controllers (Room Controllers): Room-based controllers located above accessible ceilings.
2. Interior Lighting Control System Network Connectivity for System Devices, Components, and Accessories: Low voltage cabling.
3. Exterior (Site) Lighting Control System Network Connectivity for System Devices, Components, and Accessories: Physical low voltage cabling.
4. Power Source for System Devices, Components, and Accessories: AC power pack supply.
5. Automatic Sensor Control Devices, Components, and Accessories: Field adjustable Occupancy or Vacancy.

E. Lighting Control System Programming Protocol: Manufacturer's protocol with advanced Digital Addressable Lighting Interface DALI. DALI provides digital communications to each addressable luminaire DALI driver or grouping of DALI based luminaires. Luminaire and device faults are reported to the DALI server Digital Multiplex DMX communication protocol.

F. Lighting Control System (Room-Based Controller):

1. Lighting Control System Room-Based Controller: Provide with data network to all lighting control system components, devices, and accessories. Provide network interface with other systems via BACnet IP communication or alternative protocol acceptable to the other system. System communication protocol shall be compatible with the building automation system.

G. Time Clock and Scheduling: Provide 24 astronomical hour-based scheduling for interior lighting controls.

H. Room-Based System Controllers (Room Controllers): Distributed room-based controller, integral switching relays and dimmers, network connected.

1. Installation: Provide a dedicated controller for each space; not shared with adjacent rooms. Locate the controller near the associated wall controller, near the entry door when applicable, and above the finished accessible ceiling. As an alternative, the controller may be mounted above the finished accessible ceiling of the adjacent space when the associated ceiling space is not accessible. Example, located in adjacent corridor.

I. Programming and Commissioning Dongle (Removable Style): Provide and permanently install a programming dongle for each room controller when a field removable dongle type device is required for programming and commissioning of the system. The programming dongle shall be permanently installed to allow for ease of programming the controller without above ceiling access.

J. Control Devices: All automatic sensors (ultrasonic, PIR, dual technology, daylighting, photocell, timers), control stations, and other system components shall be provided with the system and designed to operate on system network. Sensors shall be powered from power supplies, modules, packs, or Power Over Ethernet POE. Refer to Standalone Line and Low Voltage Lighting Controls section of this specification for sensor performance descriptions (not duplicated in this section).

K. Power Supplies (Modules, Packs, etc.): Provide power supplies for control devices. Power supply shall provide physical separation of 120/277 volt line voltage wiring and low voltage control wiring. Provide supplementary power supplies when required for multiple control devices. Provide switch or dimmed control as required by the Sequence Of Operation SOO.

1. Installation: Install adjacent to wall room controller when applicable, near the entry door when applicable, and above the finished accessible ceiling. As an alternative, the controller may be mounted above the finished accessible ceiling of the adjacent space when the associated ceiling space is not accessible. Provide low voltage wiring to applicable control devices and control stations.

L. Device Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125-volt AC for tungsten filaments and 20 A, 277-volt AC for electronic ballasts, minimum 50,000 cycles at rated capacity. Provide supplemental relays when required. (Example, occupancy sensor control of receptacle outlets or VAV/TAB HVAC units located in the same space.)

1. Receptacle Outlet Control: Provide auxiliary relay to control receptacle outlets located in the control space. Refer to the drawings and sequence of operation schedule for requirements.
2. Building Automation Interface: Provide auxiliary relay to report occupancy status of each individual space to the building automation system. Refer to the drawings and sequence of operation schedule for requirements.

M. **SW-#B**; Lighting Control Station, Default Dimming Control Raise/Lower/Fade: The lighting control station shall comply with the performance requirements of the lighting sequence of operation. The control station may consist of switches, pushbuttons, sliders, dimming functions, etc. Provide a common coverplate for lighting control stations.

1. #B: The '#' indicates the minimum quantity of unique lighting control scenes when shown plus raise/lower and lights 'off' scene. Refer to the Lighting Sequence Of Operation (SOO) for the minimum quantity of scenes required (when a number is not designated) and a description of each control scene.
2. Subscripts:

   a. (BLANK) = Dimming Control (Default)
   b. S = Switch Control
   c. W = Wireless w/ battery
   d. # = Unique ID when applicable

3. Manufacturer: Room-Based Lighting Controller Manufacturer:

   a. Dimming (Blank) or Switch (S) Control Station: Modular, momentary pushbutton, with addressable capabilities to control the scene or luminaires assigned to the switch. The switch shall be able to actuate the functions based on the described sequence of operation and intended functions.

      1) Preset/fader stations shall operate using programmable buttons and/or faders as indicated on drawings.
      2) Raise, Lower, Integral Fader Control: Provide control station with manual raise and lower fader control for each control zone of lighting control. Manual raise/lower shall be separate buttons from scene control; hold and dim scene control buttons not acceptable. Faders may be physical sliders or up/down buttons. Fader range shall provide continuous even dimming matching full range of dimmer specification.
      3) Integral Pilot Light or LED: Indicate that controls are active or powered by being on continuously when powered or when pushbuttons are actuated.
      4) Labeling of buttons and faders shall be engraved/screened by manufacturer, using approved text returned with shop drawing submittals.
      5) Station control components shall be designed to operate standard default or custom system functions. Components shall operate default functions unless re-assigned via direct or network connection. Function options include: preset selection, manual mode, record mode, station lockout, raise/lower, macro, cue, and room join/separate.

6) Multiple stations (shown in same space): When multiple control stations are shown in the same space the sequence of operation shall be the same at all locations unless noted otherwise.
7) Multiple stations (movable partitions in same space): When multiple control stations are shown in the same space with movable partitions the sequence of operations shall be the same at all locations unless noted otherwise. A wall partition switch shall monitor the status of the movable partitions and automatically associated the control station(s) with the appropriate space based on the status of the wall partition.

2.6 AUTOMATIC LOAD CONTROL RELAY (ALCR)

A. **ALCR20;** Automatic Load Control Relay ALCR, 120/277 volt, dry/damp listed, 32°F to 113°F (0°C to 45°C) operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, UL924 listed latest edition, Electrical Code Article 700 compliant.

1. Rating:

   a. 20 amp (16 A permitted) LED driver and ballast.
   b. 10 A (1,200 watt) incandescent.

2. Lighting Control Coordination: Provide ALCR device compatible with designated lighting zone controls. Example: switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
3. Operation:

   a. ALCR device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.
   b. ALCR device shall monitor the normal power circuit and shunt/bypass the local lighting controls upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
   c. ALCR device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
   d. Equivalent Facilitation and Performance: A limitation of equivalent comparable products may require some of the required functions of the ALCR device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system:

      1) Remote test switch / fire alarm override interface.
      2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.

4. Manufacturers:

   a. LVS Controls EPC-2 (switched)
   b. LVS Controls EPC-2-D Series (0-10V dimming)
   c. LVS Controls EPC-DMX (DMX) EPC Series (alternative lighting control)
   d. Iota ETS-20 (switched)
   e. Iota ETC-20-DR (0-10V dimming)
   f. Iota ETC Series (alternative lighting control)

g. Myers Emergency Power Systems RLY-SW-2 (switched)
h. Myers Emergency Power Systems RLY-DIM-2D (0-10V dimming)
i. Myers Emergency Power Systems RLY Series (alternative lighting control)
j. Nine24 Inc ELCR-R (switched)
k. Nine24 ELCR-Z10 (0-10V dimming)
l. Nine24 ELCR Series (alternative lighting control)
m. Lighting control manufacturer

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

A. Schedule a pre-construction meeting with the controls representative, installing contractor, COR, and Government to explain the proposed lighting control system and integration with other systems as when applicable per the design documents.

3.2 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. All wiring shall be installed in conduit.

C. Low Voltage Cabling (less than 100 volts): Low voltage lighting control cabling shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage lighting control cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.

1. J-hooks; batwing type.
2. Bridle rings with saddle supports.
3. Low voltage cable batwings supported by independent luminaire support systems (luminaire support cabling); use of batwings on ceiling support systems not allowed.
4. Listed cable ties. Low voltage cabling secured to exterior of luminaire power raceway.

D. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

E. Lighting Control Station Wiring: Provide the grounded (neutral) conductor portion of the branch circuit with the line voltage phase conductors at each lighting control station.

F. Lighting Control Panel Directories: Provide a typewritten directory for each lighting control panel indicating relay/dimmer and description of load controlled.

3.4 INTEGRATION WITH OTHER SYSTEMS

A. The Room-Based lighting control system interacts, is controlled by, or controls the following other systems per the design documents and lighting sequence of operations descriptions. The contractor shall provide the necessary communication gateways, relays, cabling, and programming to interact with the following systems.

1. Fire Alarm and Automatic Detection System
2. Shade Raise/Lower Controls

3.5 BRANCH CIRCUIT POWER WIRING FOR CONTROLLERS

1. Branch circuit power for the following lighting control system components shall be provided from the following branches. Lighting control power shall originate from the same branch circuits serving the controlled luminaires:

   a. Lighting Control System (Physical Server, Central Station, or Cloud-based Access): Emergency (Electrical Code Article 700)
   b. Room controllers, lighting control power supplies, devices, components, and accessories when an associated (ALCR) device is applicable to the lighting control sequence of operation: Emergency (Electrical Code Article 700)
   c. Room controllers, lighting control power supplies, devices, components, and accessories when an associated (BCELTS) device is applicable to the lighting control sequence of operation: The load side of the BCELTS device normal and emergency/life safety pending the status of the BCELTS.
   d. The contractor shall coordinate the branch circuit power source required with the Engineer when required for unique lighting control system devices, components, and accessories.

3.6 LOW VOLTAGE LIGHTING CONTROL CABLING

A. Control Cable Raceway Routing: All wiring shall be installed in conduit.

B. Control Cabling Installed with Line Voltage Wiring: When low voltage control cabling is installed with line-voltage wiring, the control wiring shall be, copper conductors, minimum 16 AWG or per manufacturer, with cable insulation equal to the line-voltage rating (voltage, temp rating, etc.) and comply with Specification Section 26 05 13 "Wire and Cable."

C. Network Cabling: As required by manufacturer.

D. Splices and Taps: Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

3.7 AUTOMATIC LOAD CONTROL RELAYS (ALCR20, ALCR3) AND BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH (BCELTS)

A. Field install per manufacturer requirements.

B. Fire Alarm Override: Provide connection to addressable fire alarm relay.

3.8 SUPPORT SERVICES

A. System Startup:

1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.

B. Pre-Program, Testing, Training Coordination:

1. The construction documents and sequence of operations define the original design intent of the lighting controls as coordinated between the owner and the design team. The definition of the scope is intended to identify the hardware and programming flexibility required prior to programming, system testing, and owner training.
2. The final system programming, control station labels, scene presets, dimmer presets, dimmer range limits, fade times, etc. are subject to on site coordination between the design team, owner, contractor, and manufacturer. Contractor/manufacturer programming of the system prior to an onsite coordination with the owner and design team shall not be considered final programming nor commissioning.
3. The contractor and manufacturer shall provide on site representatives to provide final programming including preset, scene, switch labeling, and other programming adjustments based on owner and design team onsite observation and verbally requested adjustments as part of the based bid scope of work.
4. The contractor shall document onsite requested changes and update operation and maintenance manuals to match final programming.

C. Testing:

1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Government. The following procedures shall be performed at a minimum:

    a. Confirm automatic sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
    b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.
    c. Confirm that schedules and time controls are configured to meet specified performance criteria and Government's operating requirements.
    d. Confirm control station labeling, presets, switch labels, and scenes.

3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.
4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.

    a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
    b. Mask occupancy/vacancy sensors where necessary to prevent nuisance switching from adjacent areas.

D. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Government personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.
2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two (2) weeks after initial training.

E. Documentation:

1. Manufacturer shall provide system documentation including:

    a. System one-line showing all panels, number and type of control stations and sensors, communication line, and network or building automation system BAS interface unit.
    b. Drawings for each panel showing hardware configuration and numbering.
    c. Panel wiring schedules.
    d. Typical diagrams for each component.

3.9 SYSTEM COMMISSIONING

A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 01 09 00, General Commissioning, for further details.

B. Mask sensors where necessary to prevent nuisance switching from adjacent areas.

C. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Agent. Refer to Section 01 09 00, General Commissioning, for system verification tests and commissioning requirements.

D. Training of the Government's operation and maintenance personnel is required in cooperation with the Government's Representative. The instruction shall be scheduled in coordination with the Government's Representative after submission and approval of formal training plans. Refer to Section 01 09 00, General Commissioning, for Contractor training requirements.

END OF SECTION 26 09 33

SECTION 26 22 00 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dry type two winding transformers (TR-#)

1.2 REFERENCES

A. NEMA - ST 1 - Specialty Transformers

B. NEMA ST 20 - Dry Type Transformers for General Applications

C. ANSI/IEEE C57.12.01 - General Requirements for Dry Type Distribution and Power Transformers

D. ANSI/IEEE C57.12.91 - Test Code for Dry Type Distribution and Power Transformers

E. Department of Energy 10 CFR Part 431 - Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.

F. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers

G. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 35, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Section 26 05 00.

B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 DRY TYPE TWO WINDING TRANSFORMERS

A. Acceptable Manufacturers:

1. Square D 7400 EX##T / SK300##KB Series
2. Eaton V48M / H48M / B48M Series
3. ABB 9T Series
4. Hammond SG / SMK Series
5. Siemens 3F3 Series

B. Dry Type Transformers: NEMA ST 20, factory-assembled, air-cooled dry type transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.

C. Insulation system and average winding temperature rise for rated KVA as follows:

Ratings	Class	Rise (degree C)
Less than 15	185	As shown on the drawings
or higher	220	As shown on the drawings

D. Case temperature shall not exceed 40°C rise above ambient at its warmest point.

E. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

F. Winding Taps, Transformers 15 KVA and Larger: Two (2) 2-1/2% below and two (2) 2-1/2% above rated voltage, full capacity taps on primary winding.

G. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

	Average Sound Level, Decibels			
	Self-Cooled Ventilated			Self-Cooled Sealed
Equivalent Winding kVA Range	K-Factor = 1 K-Factor = 4 K-Factor = 9	K-Factor = 13 K-Factor = 20	Forced Air w/ Fans Running	
0-9	40	40	67	45
9.01-30.00	45	45	67	50
30.01-50.00	45	48	67	50
50.01-150.00	50	53	67	55
150.01-300.00	55	58	67	57
300.01-500.00	60	63	67	59
500.01-700.00	62	65	67	61
700.00-1000.00	64	67	67	63

H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

J. Coil Conductors: Continuous windings with terminations brazed or welded.

K. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: NEMA TP 3; Include transformer connection data and overload capacity based on rated allowable temperature rise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount transformers on four 3”x3”x1/2” thick, 50 durometer rubber vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Ventilated transformers: Provide factory label on horizontal surface to prohibit storage on top, front, or adjacent to transformer.

E. Install primary, secondary, and grounding electrode conductors using factory or field fabricated enclosure entries. Conductors shall not be routed through ventilated openings.

3.2 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments. Adjustments shall be made at completion of project and at approximately 6 months following project acceptance when requested by the Government.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service and distribution panelboards: DP-#

B. Lighting and appliance branch circuit panelboards: Panel '###'

1.2 RELATED SECTIONS AND WORK

A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers

B. NEMA PB 1 - Panelboards

C. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

D. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment

E. UL 67 - Panelboards

1.4 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Arc Energy Reduction Documentation: Submit documentation to demonstrate the arc energy reduction system is set to operate at a value below the available arcing current.

D. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Government.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.
2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Manufacturers:

a. Square D QMB, I-Line
b. ABB ReliaGear neXT
c. Siemens F2, P4
d. Eaton PRL4, PRL5

B. Panelboards: NEMA PB 1; type as shown on the drawings.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240-volt panelboards; 50,000 amperes rms symmetrical for 480-volt panelboards, or as shown on the drawings.

H. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

I. Arc Energy Reduction:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps.

2. Energy-Reducing Maintenance Switch: Provide an energy-reducing maintenance switch visual status indication when engaged. Install the maintenance switch in the first section of the electrical equipment.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Manufacturers:

a. Square D NQ, NF
b. ABB ReliaGear Series
c. Siemens P1
d. Eaton PRL1, PRL2

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.

J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION 26 24 16

SECTION 26 24 19 - MOTOR CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters and switches

1.2 RELATED SECTIONS AND WORK

A. Refer to the Disconnect and Starter Schedule, Electrical Riser Diagram, and Equipment Connection Schedule for rating and configuration.

1.3 REFERENCES

A. ANSI/UL Standard 508. Standard for Industrial Control Equipment

B. FCC Rules and Regulations, Part 15, Subpart J- Radio Frequency Interference

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted

F. IEEE Standard 519-1981 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters

G. NEMA AB 1 - Molded Case Circuit Breakers

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

I. NEMA ICS 6 - Enclosures for Industrial Controls and Systems

J. NEMA KS 1 - Enclosed Switches

K. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; wiring diagrams that differentiate between manufacturer-installed and field-installed wiring; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

C. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and over-current protective devices.

D. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Government.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Deliver in 60-inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

C. Store and protect products under provisions of Section 26 05 00.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from fumes, dirt, water, construction debris, traffic, and physical damage.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS MS-# AND SWITCHES MX-#

A. Acceptable Manufacturers:

1. Square D 2500 Series
2. Eaton MS Series
3. ABB
4. Siemens SMF / MMS Series

B. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.

C. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.

D. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, and toggle operator.

E. Enclosure: NEMA ICS 6; Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.

B. Select and install heater elements in motor starters to match installed motor characteristics.

C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION 26 24 19

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Device plates and box covers

B. Receptacles (REC-#)

C. Cord and plug sets

1.2 QUALITY ASSURANCE

A. Provide similar devices from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Electrical Code, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

C. Comply with the Electrical Code.

1.3 REFERENCES

A. DSCC W-C-896F - General Specification for Electrical Power Connector

B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet

C. NEMA WD 1 - General Color Requirements for Wiring Devices

D. NEMA WD 6 - Wiring Devices - Dimensional Requirements

E. NFPA 70 - National Electrical Code (NEC)

F. UL 498 - Standard for Attachment Plugs and Receptacles

G. UL 943 - Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.5 COORDINATION

A. Receptacles for Government Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All switch, receptacle, and outlet colors shall be white, unless indicated otherwise.

2.2 COVERPLATES

A. All switches, receptacles, and outlets shall be complete with the following:

1. #302 stainless steel coverplates in finished spaces where walls are finished.
2. #302 stainless steel coverplates in unfinished spaces for flush boxes.
3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

A. Refer to Electrical Symbols List for device type.

B. Devices that are shaded on the drawings shall be red.

C. REC-DUP: NEMA 5-20R Duplex Receptacle:

1. Heavy Duty: 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.

a. Manufacturers:

1) Hubbell 5362
2) Leviton 5362
3) Pass & Seymour 5362A
4) Cooper AH5362

D. REC-DUP-GFI: NEMA 5-20R Ground Fault Duplex Receptacle:

1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, listed.

   a. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
   b. Manufacturers:

      1) Hubbell GF20L
      2) Leviton GFNT2
      3) Pass & Seymour 2097
      4) Cooper SGF20

E. REC-DUP-W: NEMA 5-20R Weatherproof While-In-Use Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, weather resistant WR listed. Provide extra-duty NEMA 3R rated while-in-use cast aluminum outlet box hood.
2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

   a. Manufacturers:

      1) Hubbell:

         a) GFRTW20 with aluminum housing WP826

      2) Leviton GFWT2 with aluminum housing M5979
      3) Pass & Seymour 2097TRWR with aluminum housing WIUCAST1
      4) Cooper WRSGF20 with aluminum housing WIUMV-1

F. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

G. Side wired devices shall have four binding screws that are undercut for positive wire retention.

H. Ground fault circuit interrupter (GFCI) receptacles shall be listed and comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

C. Ground Fault Protection: Provide ground fault protection for all branch circuit breakers serving 120/208 receptacles and electrical outlets rated 50 amps or less single-phase and 100 amps or less three-phase in the following locations, as shown on drawings, or required by adopted code:

1. Bathrooms, locker rooms, shower rooms
2. Rooftops
3. Interior/Exterior locations subject to damp/wet conditions
4. When located within 6 feet of sinks, bathtubs, and shower stalls
5. Plug-and-cord receptacles when the utilization appliance is located within 6 feet of a sink edge.
6. Specific Appliances: Auto vacuum machines, water drink/bottle fill coolers, pressure staying machines, tire inflation machines, vending machines, sump pumps, dishwashers, electric ranges, ovens, clothes dryers, microwave ovens
7. Horticultural luminaire branch circuits

D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

F. Install devices and wall plates flush and level.

G. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.

H. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses

1.2 REFERENCES

A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types

B. UL 198E - Class R Fuses

C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

D. NEMA FU 1 - Low Voltage Cartridge Fuses

E. NFPA 70 - National Electrical Code (NEC)

1.3 EXTRA MATERIALS

A. Provide two fuse pullers.

B. Provide three of each size and type of fuse installed.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40°F or more than 100°F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - FUSES

A. Bussman, Division of Eaton

B. Edison Fuse, Division of Cooper Industries

C. Mersen

D. Littelfuse Inc

2.2 FUSES

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.

D. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.

E. Control transformer fuses: Class CC (time delay).

F. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated on the drawings and specifications.

B. Install fuses in accordance with manufacturer's instruction.

C. Install fuses in packaged equipment as required by equipment manufacturer.

D. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 26 28 13

SECTION 26 28 16 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches

B. Non-fusible switches

1.2 RELATED SECTIONS AND WORK

A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Product Data: For each type of enclosed switch, circuit breakers, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.

C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

A. Acceptable Manufacturers:

1. Square D 3110 Series
2. Eaton DH Series

3. ABB TH Series
4. Siemens HNF / HF Series

B. FDS-**#**; Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

C. DS-**#**; Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.

D. Enclosures: Type as indicated on the disconnect schedule.

E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.

1. Lockable
2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on the drawings.

B. Install fuses in fusible disconnect switches.

C. Field coordinate installation with other equipment to maintain code required working space requirements.

D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION 26 28 16

SECTION 26 43 00 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes materials and installation requirements for factory and field wired low voltage surge protection devices (SPD) for the protection of all AC electrical circuits. SPD equipment to be installed at designated panels.

1.2 QUALITY ASSURANCE

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be "Listed by Underwriters Laboratories" to UL 1449.

B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.3 REFERENCES

A. ANSI/IEEE C62.33 - IEEE Guide on Testing of MOV components

B. ANSI/IEEE C62.35 - IEEE Guide on Testing of SAD components

C. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits

D. ANSI/IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits

E. ANSI/UL 1449 Latest Edition - UL Standard for Safety for Surge Protective Devices

F. CBEMA - Computer Business Equipment Manufacturers Association

G. IEC 664 - International Engineering Consortium, Standard for Clamping Voltage

H. NFPA 70 - National Electrical Code (NEC)

I. UL 67 - Listed for Internal Panelboard Transient Voltage Surge Suppressors

J. UL 96A - Devices listed as approved for secondary surge arrestors (VZCA)

K. UL 248-1 - Fusing

L. UL 1283 - Electromagnetic Interference Filters, Fifth Edition

1.4 SUBMITTALS

A. Shop Drawings: Should include device dimensions, mounting requirements including wire size and over-current protection device rating, nameplate nomenclature, electrical ratings, short circuit current rating, and test results as indicated below under "Testing, Warranty and Life Expectancy" as provided by an independent test lab or a UL certified test lab for the category(ies) of suppression device(s) specified using the appropriate IEEE test wave. Product data sheets with installation instructions for each size and type of device are required. Shop drawings submitted without the testing data as required by section this section will be rejected.

B. Fuse information: Provide fuse information if required for operation. Include size, manufacturer, time-current chart responses to UL 1449 testing requirements, maximum surge protection capability per mode and phase as limited by the fuse, and verification of repetitive surge protection device operation without system degeneration greater than 10%.

1.5 SPARE PARTS

A. Fuses: Furnish to the Government 3 spare fuses of each type and rating installed.

1.6 TESTING, WARRANTY AND LIFE EXPECTANCY

A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.

1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge currents.
2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage (VPR).
3. A single 8 x 20µs waveform pulse of maximum rated surge current per mode shall then be applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

B. Minimum Repetitive Surge Current Capacity:

1. Minimum Repetitive Surge Current Capacity Test:

   a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage.
   b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit current waveform, shall then be applied at one-minute intervals.
   c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

2. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.
3. Proof of such testing shall be the test log generated by the surge generator.

C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD unit submitted for this product using the 6kV/3kA combination wave surge.

D. Warranty: Ten (10) years. Includes workmanship, installation and programming.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit shall provide protection in all normal modes for "wye" and "delta" systems.

B. Short Circuit Current Rating: Provide factory label for SCCR rating. The short circuit current rating shall be the larger of the listed value on the drawings or as required by the equipment protected.

C. Type Definitions - Permitted Installation Locations:

1. Type 1. Supply-side or Load-side of service disconnect. Load-side of service disconnects when listed for application and approved.
2. Type 2. Load-side of service disconnect or separately derived system.
3. Type 3. Load-side of branch circuits.
4. Type 4. Integral to Original Equipment Manufacturer OEM equipment, factory installed.

2.2 RATINGS

A. **SPD-1** Secondary Distribution Suppressors:

1. For 120/208-volt, 3 phase, 4 wire, type 2 unit.

   a. Surge current capacity: 100,000/200,000 amps per protection mode/phase
   b. Nominal Discharge Current (I_N): 20 kA.
   c. Mounting: Refer to the drawings.
   d. Voltage Protection Rating: Refer to requirements below.
   e. Components: Minimum component size of 20mm metal thermally protected oxide varistors (MOV).

2. Manufacturers:

   a. Square D Surgelogic EM# Series
   b. Siemens TPS4 or BSPD Series
   c. Eaton SPD Series
   d. ABB Current Technology Current Guard Plus
   e. ASCO Power Technologies 5## Series
   f. LEA International CFS Series

B. Voltage Protection Rating:

1. Protection modes and UL 1449 voltage protection rating for surge suppression units per each mode (L-N, L-L, L-G, and N-G as appropriate).

a. 120/208 Volt, 3 phase, 4 wire. 700 Volt L-N, N-G, 800 Volt L-G and 1200 Volt L-L

C. EMI/RFI Noise Rejection or Filtering:

1. Each unit shall include a UL1283 first order, high-frequency filter for noise filtering between 10 KHz and 100 MHz.

D. Indication:

1. Each unit shall include solid-state indicators with externally mounted LED visual status indicators that indicate on-line status of each protection mode of the unit.
2. Each unit shall include a visual indicator that indicates the unit is functioning properly and providing protection.
3. Each unit shall include an audible alarm with silencing switch to indicate when protection has failed.
4. Each unit shall contain form "C" contacts for remote indication of an alarm status.

E. Fuses:

1. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit.
2. Fuses shall be rated 200, 000 AIC minimum interrupting capacity.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine equipment for size and type of surge protection device to be used to ensure physical compatibility.

B. Inspect surge protection device for any signs of physical damage due to shipping or handling before installing surge protection device.

3.2 INSTALLATION

A. Mounting Location:

1. The unit shall be installed as close as practical to the panel secondary lugs in accordance with applicable national/Local Electrical Codes and the manufacturer's recommended installation instructions. Connect the unit to the panel using a conduit nipple.

B. Connections:

1. Conductors from the protected bus to the unit shall not be any longer than necessary avoiding unnecessary bends. The conductor leads shall be twisted together and as short as possible. Connection shall be with mechanical lugs for each phase, neutral, and ground if applicable. Contractor shall provide wire and circuit breakers sized per the approved manufacturer's requirements. Maximum lead length from protected bus to surge protection device shall be per manufacturer's requirements, but no greater than 5'-0".
2. The surge protection unit shall be isolatable from the electrical distribution system via 3 pole circuit breaker mounted in the switchboard/panelboard or be equipped with a factory supplied integral fused switch or circuit breaker. Single phase 120-volt units shall be hardwired without a disconnecting means.
3. Neutral and ground shall not be bonded together at secondary panelboard locations.

C. General:

1. Check unit for proper operation of protection and indication under start-up.
2. Check unit to ensure all MOVs for each mode of protection are operational. Verify integral fuse links are operational and have not melted.
3. Surge suppression devices shall not be installed ahead of the main service disconnect(s).
4. Install fuses in all fuse holders and fused disconnects internal to the surge protection unit. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit. External fusing of the surge protection device is not allowed.
5. Coordinate location of surge protection device to allow adequate clearances for maintenance.

END OF SECTION 26 43 00

SECTION 26 51 19 - LED LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories

B. Exterior luminaires and accessories

C. Light-emitting diode (LED) luminaire systems

D. Emergency exit signs

E. Lighting poles

1.2 RELATED SECTIONS

A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:

1. 26 09 33 Lighting Control Systems

    a. Automatic load control relay (ALCR) (individual luminaire - integral) (ALCR3)

2. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 REFERENCES

A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products

B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement

C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment

D. NFPA 70E - National Electrical Safety Code

E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System

F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products

G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED

I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)

J. UL 924 - Standard for Emergency Lighting and Power Equipment

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Basic Requirements of Submittal:

1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
3. Include outline drawings, support points, weights, and accessory information for each luminaire.
4. Submit manufacturer origin of LED chipset and driver.

C. LED Lighting - Performance Testing Submittal (when requested by COR):

1. IESNA LM-79: Include photometric report for the latest generation system being furnished. Provide name of independent testing laboratory, report number, date of test, luminaire series/model number, input wattage, and light source specifications.
2. IESNA LM-80: Measuring Lumen Maintenance of LED Light Sources.

D. LED Lighting - Control Compatibility Submittal:

1. Submit lighting control capability data for each LED luminaire. The submittal shall clearly identify device data proposed by the Contractor and approved by the luminaire manufacturer for dimming, switching, addressable, wireless, and similar control characteristics.

E. Submit utility rebate forms where offered at project location. Submit completed rebate forms within 30 days of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.6 WARRANTY

A. The warranty period begins at the date of Substantial Completion.

B. LED Light Engines and Drivers:

1. LED Drivers and Dimming Drivers: Five (5) years
2. Light Emitting Diode (LED) Light Engines: Five (5) years

C. Emergency Lighting Units and Exit Signs:

1. Exit Signs: Three (3) year, non-prorated

D. Automatic Load Control Relay (ALCR): Five (5) year

E. Pole Finish: Three (3) year warranty of pole color and finish

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.

B. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.

C. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified. Verify suspension length prior to submittal.

D. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Listed for wet or damp location as scheduled. Provide ingress protection (IP) rating when scheduled.

B. Provide low temperature LED drivers, with reliable starting to -20□F.

C. Exterior LED luminaires shall contain separate, easily accessible and replaceable Category C surge protection device.

2.3 HORTICULTURAL LUMINAIRES

A. Horticultural luminaires shall be labeled for the application, safety cable connection to support structure, cord and plug electrical connection.

B. Branch Circuit Protection:

1. Provide GFCI branch circuit protection for luminaires operating at 120-volts or less.
2. Provide special SPGFCI circuit protection for luminaires operating in excess of 150-volts.

2.4 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Refer to the luminaire schedule for color temperature and minimum color rendering index CRI requirements. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.

B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.

C. Rated life shall be minimum of 50,000 hours at L70.

D. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

E. Luminaire delivered lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.

F. LED luminaires shall be designed for ease of component replacement including modular replaceable boards or Zhaga sockets. Luminaires that are factory sealed and do not have field replaceable parts shall provide a 10-year warranty.

G. LED light engine shall have a maximum LLD of 0.85 at 50,000 hours at 25°C ambient.

H. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Driver shall have a voltage fluctuation tolerance of +/- 10%.
2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
3. Driver shall have a minimum of 50,000 hours rated life.
4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.
5. Driver shall be field replaceable without removal of the luminaire.
6. Class A sound rating; inaudible in a 27 dBA ambient.
7. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

2.5 EMERGENCY EXIT SIGNS

A. Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.

B. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all requirements of NFPA 101.

2.6 LIGHTING POLES

A. Manufacturers:

1. Manufacturer of luminaire (metallic pole)
2. Valmont Poles (metallic pole)
3. U.S. Pole Company (metallic pole)
4. KW Industries (metallic pole)

B. Metal Poles: Round straight aluminum lighting pole with anchor base.

1. Anodized aluminum finish to MIL-A-8625 Type II, minimum 0.8 mil thickness. Provide anodized color sample to COR prior to ordering.

C. Wind Load: 100 MPH velocity, with 1.14 percent three-second gust factor with luminaires and brackets mounted.

D. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.

E. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.

F. Vibration Damper: Canister or snake type second mode vibration damper internal to the metal pole as recommended by pole manufacturer. Provide additional pole top damper for first mode vibration on single-head metal poles where recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.

1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:

a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
b. Luminaires 56 lbs or greater: Provide a minimum of four (4) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires. Support luminaire independent of the ceiling system.

c. Luminaires larger than eight square feet (8 ft2): Support luminaire independent of the ceiling system.

B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.

C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.

D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.

E. Install lamps in lamp holders of luminaires.

F. Industrial Pendant Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between driver and structure. Provide safety chain between reflector and driver.

G. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

H. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES

A. The Contractor shall provide temporary construction lighting per the requirements of Division 1.

B. The project luminaires shown on the construction documents shall not be used for temporary construction purposes without providing a plan for Government approval that addresses energy and luminaire operating hours.

3.3 AUTOMATIC LOAD CONTROL RELAYS

A. Factory or field installation per manufacturer requirements.

B. Fire Alarm Override: Provide connection to addressable fire alarm relay.

3.4 EMERGENCY LIGHTING UNITS AND EXIT SIGNS

A. Install units plumb and level.

B. Aim directional lamp heads as directed.

C. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion. Provide electronic copy of periodic test log form to Government's Representative. Explain and instruct Government's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.5 RELAMPING

A. Replace failed LED light engine modules or arrays at completion of work.

3.6 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire and pole finish at completion of work.

3.7 OWNER TRAINING

A. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion, with the Government's Representative.

B. Provide electronic copy of periodic test log form to Government's Representative. Explain and instruct Government's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.8 LUMINAIRE SCHEDULE

A. As shown on the drawings.

END OF SECTION 26 51 19

SECTION 27 05 00 - BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Communications Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Communications Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Description of Systems include, but are not limited to, the following:

1. Complete Structured Cabling System including, but not limited to:

    a. Backbone cabling and terminations.
    b. Horizontal cabling and terminations.
    c. Information outlets (IOes) including faceplates, jacks and labeling.
    d. Cabinets, cable management, and equipment.
    e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
    f. Cabling pathways.
    g. Grounding and bonding
    h. Testing

2. Complete Data Communications Equipment Systems.
3. Complete Voice Communications Equipment Systems.
4. Complete Paging Systems.
5. Mounting and patching of wireless access points provided by others.
6. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.
7. Firestopping of penetrations as described in Section 27 05 03.

1.3 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

   a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
   b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
   c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
   d. Maintenance clearances and code-required dedicated space shall be included.
   e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Government.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).
      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Government's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
   b. Potential layout changes shall be made to avoid additional access panels.

c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Government's Representative.
e. When additional access panels are required, they shall be provided without additional cost to the Government.

10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.4 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling
b. ANSI/TIA-568-0-D - Generic Telecommunications Cabling for Customer Premises

1) 1-D - Commercial Building Telecommunications Standard
2) 2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
3) 3-D - Optical Fiber Cabling Components Standard

c. ANSI/TIA-569-E - Telecommunications Pathways and Spaces
d. ANSI/TIA-606-C - Administration Standard for Commercial Telecommunications Infrastructure
e. ANSI/TIA-607-D - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
f. ANSI/TIA-758-B - Customer-Owned Outside Plant Telecommunications Standard
g. ANSI/TIA-862-A - Building Automation Systems Cabling Standard
h. ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers
i. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
j. ANSI/TIA-1179 Healthcare Facility Telecommunications Standard
k. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding
l. NFPA 70 (NEC) - National Electrical Code (Current Edition)
m. UL 444 - Standard for Safety for Communications Cable

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.
3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.
4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.
6. The Contractor shall obtain the services of a BICSI RCDD (Registered Communications Distribution Designer) or CNet CNIDP (Certified Network Infrastructure Design Professional) for the project. The RCDD or CNIDP shall perform the following tasks on the project:

    a. Review contractor's submittals and stamp the submittals stating the submittals compliance with the contract documents.
    b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every 2 weeks during the construction period.
    c. Provide a final written and dated confirmation of a final construction review prior to testing.
    d. Review final testing of system and indication that the documented results or transmittal of the results stating the test results compliance with the contract documents.

7. The Contractor shall have certified BICSI installation technicians or CNet CNIT (Certified Network Infrastructure Technician) on staff to perform the following tasks on the project:

    a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.
    b. Oversee all testing and termination of cabling.

8. The Contractor shall have certified BICSI Installer 2 or CNet CNCI (Certified Network Cabling Installer) on staff to perform the following tasks:

    a. Installation and termination of copper cable.
    b. Installation and termination of optical fiber.

9. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

    a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.
    b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
    c. A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic systems on the project.

d. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.
e. Resume and certification of the RCDD or CNIDP for the project as required by the form at the end of this specification section.
f. Resume and certification of the BICSI installation technician or CNet CNIT for the project.

D. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Des Moines, IA Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of USDA. .
3. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
4. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal a separate price required to make the system shown on the drawings comply with the codes and regulations.
6. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
7. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Government.

E. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Government or authorized independent agency/consultant.
7. Pay any charges by the service provider related to the service or change in service to the project.
8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):

   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

F. Service Provider Requirements:

1. Secure from the telecommunications service provider all applicable requirements.
2. Comply with all service provider requirements.

3. The Government shall make application for and pay for new telecommunications service equipment and installation. The Contractor shall coordinate schedule and requirements with the Government and service provider.

G. Examination of Drawings:

1. The drawings for the technology systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Government.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
4. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
6. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

I. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Architect/Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Architect/Engineer will be borne entirely by the Contractor.

1.5 WEB-BASED PROJECT SOFTWARE

A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.

B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.

C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.

D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.6 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
27 05 03	Through Penetration Firestopping
27 05 26	Communications Bonding
27 05 28	Interior Communications Pathways
27 05 53	Identification for Communication Systems
27 11 00	Communication Equipment Rooms
27 13 00	Backbone Cabling Requirements
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 51 13	Paging Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Description of items submitted and relevant specification number
e. Notations of deviations from the contract documents
f. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

    a. Date
    b. Project title and number
    c. Architect/Engineer
    d. Contractor and subcontractors' names and addresses
    e. Supplier and manufacturer's names and addresses
    f. Description of item submitted (using project nomenclature) and relevant specification number
    g. Notations of deviations from the contract documents
    h. Other pertinent data
    i. Provide space for Contractor's review stamps

3. Composition:

    a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
    b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
    c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:

    a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
    b. Unstamped submittals will be rejected.
    c. The Contractor shall provide proof of RCDD or CNIDP review on the submittal.
    d. The Contractor's review shall include, but not be limited to, verification of the following:

        1) Only approved manufacturers are used.
        2) Addenda items have been incorporated.
        3) Catalog numbers and options match those specified.
        4) Performance data matches that specified.
        5) Electrical characteristics and loads match those specified.
        6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
        7) Dimensions and service clearances are suitable for the intended location.
        8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
        9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

e. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
f. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements**.**

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
   b. The Contractor shall clearly indicate the size, finish, material, etc.
   c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
   d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Government if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Government or other contractors.

    a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.

16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. Submittal file name: 27 XX XX.description.YYYYMMDD
    b. Transmittal file name: 27 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.7 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.

B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.

C. Change order work shall not proceed until authorized.

1.8 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

    1. Firestopping, including mechanical firestop systems.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Government.

1.11 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Government or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.13 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 CABLE JACKET RATING

A. This project requires all cable jackets to carry a plenum rating.

2.2 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 27 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.
5. All communications cable tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Government may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Government a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
2. Submitted bound copies of approved shop drawings.
3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.
4. Submitted a report stating the instructions given to the Government's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Government's representative as having received the instructions.
5. Submitted testing reports for all systems requiring final testing as described herein.
6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.
8. Provide System Assurance Warranty certificate for the telecommunications system.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Government's possession prior to Government's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div27.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div27.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Government with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE GOVERNMENT'S REPRESENTATIVE

A. Adequately instruct the Government's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Government's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Government's representative so that their representative can be present if desirable.

D. Refer to the individual specification sections for minimum hours of instruction time for each system.

E. Operating Instructions:

1. The Contractor is responsible for all instructions to the Government and/or Government's operating staff on the Communications Systems.
2. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Government for the Architect/Engineer to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Government on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Government for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of technology drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. Record actual routing of all conduits sized 2" or larger.

E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Government's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 90% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 50% of testing has been completed.
6. Telecommunications labeling has been provided on at least 50% of each type of component requiring a label.
7. All telecommunications related grounding is complete.
8. All overhead or integrated paging systems, including speakers, back boxes, cabling, and power supplies, and all headend equipment is installed, programmed and operational.
9. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

TELECOMMUNICATIONS - PROOF OF CERTIFICATION

There are specific Contractor qualification requirements for this project as defined in Section 27 05 00, which may include Manufacturer Certification and RCDD or CNIDP credentials. This Proof of Certification document, and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:
The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer: _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____
Manufacturer Certification Number (if any): _____

If this project requires RCDD certification, complete the following:

RCDD or CNIDP Name: _____
RCDD #: _____ Expiration: _____

Submit the following with the bid:
This form.
Proof of Manufacturer Certification indicated above.
Proof of RCDD or CNIDP status.

END OF SECTION 27 05 00

SECTION 27 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 - Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. HCAI - Health Care Access and Information (California)

J. The Building Officials and Code Administrators National Building Code

K. 1997 Uniform Building Code

L. 2021 International Building Code

M. NFPA 5000 – Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Section 27 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Government at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 CFM/sq.ft. at both ambient temperature and 400F .

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Government.

1. Review foreseeable methods related to firestopping work.
2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division
2. Hilti, Inc.
3. Specified Technologies Inc. (S.T.I.)
4. Wiremold/Legrand: FlameStopper

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:

   a. F Rating = Floor/Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall Rating

   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999

Penetrating Item	UL System No.
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:

   a. F Rating = Wall/Floor Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Government, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

END OF SECTION 27 05 03

SECTION 27 05 26 - COMMUNICATIONS BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bonding Conductors

B. Bonding Connectors

C. Grounding Busbar (PBB and SBB)

1.2 RELATED WORK

A. Section 26 05 33 - Conduit and Boxes

B. Section 26 05 13 - Wire and Cable

C. Section 26 05 26 - Grounding and Bonding

D. Section 26 41 00 - Lightning Protection Systems

E. Section 27 05 00 - Basic Communications Systems Requirements

F. Section 27 05 03 - Through Penetration Firestopping

G. Section 27 11 00 - Communication Equipment Rooms

H. Section 27 05 28 - Interior Communication Pathways

I. Section 27 05 53 - Identification for Communication Systems

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.

C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

1.4 REFERENCES

A. ANSI/IEEE 1100 - Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

B. ANSI/TIA 568-C - Commercial Building Telecommunications Cabling Standard

C. ANSI/TIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces

D. ANSI/TIA 606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

E. ANSI/TIA 758 - Customer Owned Outside Plant

F. ANSI/TIA-607-D - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

G. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

H. IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

I. NFPA 70 - National Electrical Code

J. NFPA 780 - Standard for the Installation of Lightning Protection Systems

K. UL 96 - Lightning Protection Components

L. UL 96A - Installation Requirements for Lightning Protection Systems

M. UL 467 - Grounding and Bonding Equipment

1.5 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 27 05 00 and Division 1.

B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.
2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Provide CAD-generated, project-specific system shop drawings as follows:

1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.
2. Installation details for all system components.

D. Provide system checkout test procedure to be performed at acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 27 05 00.

B. Store and protect products under the provisions of Section 27 05 00.

C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.7 SYSTEM DESCRIPTION

A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.

B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.

D. Basic System Requirements:

1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-D and NFPA 70 for complete information.
2. The bonding system shall include, but not be limited to, the following major components:

    a. Telecommunications Bonding Conductor (TBC)
    b. Primary Bonding Busbar (PBB)
    c. Telecommunications Bonding Backbone (TBB)

d. Bonding Conductor(s) (BC)
e. Bonding Connectors
f. Bonding system labeling and administration as defined in Section 27 05 53.

1.8 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 05 00.

B. Provide final system block diagram showing any deviations from approved shop drawing submittal.

C. Provide floor plans that document the following:

1. Actual locations of system components, devices, and equipment.
2. Actual conductor routing.
3. Actual system component, device, equipment, and conductor labels.

D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.

E. Complete all operation and maintenance manuals as described below.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 27 05 00.

B. Submitted data shall include:

1. Approved shop drawings.
2. Descriptions of recommended system maintenance procedures, including:

a. Inspection
b. Periodic preventive maintenance
c. Fault diagnosis
d. Repair or replacement of defective components

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.
2. Minimum size 6 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.

2. Insulation:

   a. PVC insulation with nylon outer jacket.
   b. Rated at 600 volts.
   c. Green.

3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing:

1. All communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
67 - 84 (20 - 26)	3/0
85 - 105 (26 - 32)	4/0
106 - 125 (32 - 38)	250 kcmil
126 - 150 (38 - 46)	300 kcmil
151 - 175 (46 - 53)	350 kcmil
176 - 250 (53 - 76)	500 kcmil
251 - 300 (76 - 91)	600 kcmil
Greater than 301 (91)	750 kcmil

2. The TBC shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

A. Acceptable Types:

1. Two-hole compression lug
2. Exothermic weld
3. Irreversible compression

B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (PBB AND SBB)

A. Features:

1. Wall-mount configuration.
2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-D standards.
4. Predrilled holes.
5. Integral insulators.
6. Stainless steel offset mounting brackets.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating.
2. Refer to drawings for grounding busbar size(s).

   a. Minimum Dimensions: Refer to drawings.
   b. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
   c. Hole patterns on busbars accommodate two-hole lugs per the recommendation of ANSI/BICSI N3-20 and ANSI/TIA-607 standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Bonding Requirements:

1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.
2. A licensed electrician shall perform all bonding.
3. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:

1. Locate the PBB in the service entrance room unless otherwise noted on the drawings.
2. The location of the PBB shall be the shortest practical distance from the telecommunications primary lightning protection devices.
3. Bond the telecommunications primary protectors to the PBB. Maintain a minimum 1 foot separation of the bonding conductor from all DC power cables, switchboard cable, and high frequency cable.
4. In service entrance rooms where the entrance pathway contains an isolation gap, the pathway on the facility side of the gap shall be bonded to the PBB.

C. Where the service entrance cable contains a shield, the shield(s) shall be bonded to the PBB using manufacturer-approved hardware.

D. Primary Bonding Busbar (PBB) Requirements:

1. Install PBB such that it is insulated from its support with a minimum 2" standoff.
2. Bond the PBB to the electrical service ground via the TBC.

    a. A minimum of 1 foot separation shall be maintained between the TBC and any DC power cables, switchboard cable, or high frequency cables.

3. Where backbone or horizontal cabling contains a shield, the shield(s) shall be bonded to the PBB.
4. PBB shall be bonded to all electrical panels located in the same room or space as the PBB. PBB shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the PBB.
5. PBB shall be bonded to accessible metallic building structure located within the same room or space as the PBB.
6. All metallic continuous cable pathways, including, but not limited to, , raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the PBB, shall be bonded to the PBB.
7. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the PBB, shall be bonded to the PBB.

E. Metallic Interior Communication Pathway Bonding Requirements:

1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.

F. Bonding Conductor Requirements:

1. Bonding conductors shall be green or marked with a distinctive green color.
2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.
3. Bonding conductors shall not be installed in metallic conduit.
4. All conductors, including, but not limited, to the TBC, TBB, BBC, and TEBC(s), shall be installed splice-free. If the Contractor believes that site conditions do not allow a splice-free installation, the Contractor may request permission from the Architect/Engineer to splice a specific communications bonding system conductor.

    a. Where documented permission to splice a conductor is granted:

        1) The number of splices shall be limited to as few as possible.
        2) Splices shall be made using exothermic welding or irreversible compression-type connections only. Splice hardware shall be listed for grounding and bonding. Solder is not an acceptable means of splicing conductors.
        3) Splices shall be made in telecommunications spaces in accessible locations to facilitate future inspection and maintenance.
        4) Splices shall be adequately supported and protected from impact and from physical or mechanical strain or damage.

5. All bonding conductors shall be labeled in accordance with the requirements of Section 27 05 53. In addition to the requirements of Section 27 05 53:

    a. Labels shall be nonmetallic.
    b. Labels shall be printer-generated.
    c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.
    d. Additionally, conductors shall be labeled as follows:

        1) "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

6. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.
7. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.

G. Bonding Connection Requirements:

1. Make all connections in accessible locations to facilitate future inspection and maintenance.
2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.
3. Thoroughly clean conductors before installing lugs and connectors.
4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.
5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.
6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.
7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 27 05 00.

B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.

C. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

3.3 ADJUSTING

A. Adjust work under provisions of Section 27 05 00.

B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Government.

3.4 TESTING

A. Measure and document resistance to ground at PBB, each SBB, each RBB, and each electrical distribution panel bonded to the PBB or a SBB.

1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the 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. Perform tests by the fall-of-potential method according to IEEE 81.
2. The preferred measured resistance to ground for the grounding electrode system is 5 ohms or less. Refer to Division 26 for exact project requirements.
3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

B. Two-point Ground/Continuity Test:

1. Two-point ground continuity test shall be performed per TIA-607D standards.
2. Contractor shall use an earth ground resistance tester to confirm a resistance of less than 100 milliohms between the building's electrical grounding electrode system and any other point in the telecommunications bonding system.
3. At a minimum, perform tests in the following areas:

   a. PBB to the electrical ground in distributors
   b. Each SBB to the electrical ground in distributors
   c. PBB to the structural metal (if present)
   d. Structural metal (if present) to the electrical ground

4. Complete testing prior to installation of Government-provided equipment.

C. Measure and document voltage between screen of installed and terminated ScTP, FTP, and/or SSTP horizontal cables and electrical ground of electrical outlet(s) serving the information outlet location area.

1. The voltage between the screen and the ground wire shall not exceed 1.0 V rms, and 1.0 V dc for any installed and terminated ScTP, FTP, and/or SSTP horizontal cables.

D. Include measurement documentation in test data submitted at completion of project under provisions of Section 27 17 10.

END OF SECTION 27 05 26

SECTION 27 05 28 - INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 05 33 - Conduit and Boxes

B. Section 27 05 00 - Basic Communications Systems Requirements

C. Section 27 05 26 - Communications Bonding

1.2 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements.

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
2. Manufacturer's installation instructions.

B. Coordination Drawings:

1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.5 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Refer to Section 26 05 33 for conduit requirements for this project.

2.2 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.
2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.
3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use zinc plated steel, ASTM B633 SC3 suitable for heavy duty use. Provide stainless steel AISI Type 304 hooks for corrosive locations.

C. Cable Hangers:

1. Adjustable, non-continuous cable support slings for use with low voltage cabling.
2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.
3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.
4. Cabling hanger load limit shall be 100 lbs per foot.
5. Manufacturer:

    a. Erico Caddy
    b. CableCat CAT425
    c. Arlington Fittings Tl Series
    d. Or approved equal.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".

D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

A. Refer to Section 26 05 33 for additional requirements.

B. All conduits shall be reamed and shall be installed with a nylon bushing.

C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.

D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.

1. A separate pull box is required for each 90' (or greater) length section.
2. A separate pull box is required after any two (2) consecutive 90-degree bends.
3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.3 ATTACHMENT TO METAL DECKING

A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION 27 05 28

SECTION 27 05 53 - IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the identification and administration requirements relating to the structured cabling system and its termination components and related subsystems.

B. Identification and labeling.

C. Administration of structured cabling system, utilizing identifiers, records, record linkages and presentation.

1. Identifier: Information that links a specific element of the telecommunications infrastructure with its corresponding record.
2. Records: A collection of detailed information related to a specific element of the telecommunications infrastructure.
3. Record Linkage: A connection between a record and an identifier or between records.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

B. Perform all work in accordance with State of Iowa standard.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Documentation of labeling scheme.
2. Complete documentation of nomenclature for all Administration components.

PART 2 - PRODUCTS

2.1 ADMINISTRATION

A. Administrative requirements include identifiers, records, record linkages and labeling for the purposes of administering building cabling, pathways and spaces and grounding/bonding within a facility.

B. The administrative system shall be developed in Microsoft Word format or other electronics program approved by the Architect/Engineer. Should the Contractor elect to provide documentation of the administrative system in a proprietary format, the owner shall be provided with a retail licensed version of the software by the Contractor allowing the full editing and reading the documentation.

C. Refer to the Administrative System Outline below for minimum requirements.

D. Identifiers:

1. Identifiers shall be marked at the equipment to be administered.
2. Identifiers shall be unique for each type of equipment. For example, in no case shall the identifier for a cable be the same as the identifier for a pathway.

E. Records:

1. Provides descriptive information about the identified equipment.

F. Linkages:

1. To be used to describe the connection between an identifier and a record. In addition, a linkage is used to point from one record to another record.

G. Administrative System Outline:

1. Cable:

a. Cable identifier, cable type, total pair count, damaged pair count, unterminated pair count.
b. Termination records, splice records, pathway records, grounding records.

2. Primary Bonding Busbar:

a. PBB identifier, busbar type, grounding conductor identifier.
b. Bonding conductor records, space records.

3. Bonding Conductors:

a. Bonding conductor identifier, conductor type, busbar identifier.
b. Grounding busbar records, pathway records.

2.2 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface an attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.

1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum "quite zone" of 0.25" on each side of the bar code.
2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:

1. Labels on each end of a cable shall be the same color for each termination.
2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.
3. Orange (Pantone 15C) shall be used for the demarcation point.
4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.
5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)
6. White shall be used to identify the first-level backbone termination in the main cross-connect.
7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.
8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.
9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.
10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.
11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.
12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.

F. Tag all CAT 6, and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:

1. (Room Number) - (Outlet Number) - (Jack Number) - (Use).
2. "Outlet Number" shall start with 1 in each room, with additional outlets in each room numbered sequentially.
3. "Jack Number" shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.
4. "Use" shall be designated by the following:

    a. "V" for voice (RJ-45)
    b. "D" for data (RJ-45)
    c. "C" for video (coax)
    d. "M" for multimedia retrieval (coax)
    e. "S" for speaker (RCA)

5. Example #1: "106-1-1-V" indicates the top left voice jack in outlet #1 in Room 106.
6. Example #2: "109-3-4-D" indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

2.3 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms shall become the property of the Government.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling:

1. Horizontal cables shall be labeled at each end.

   a. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color may include blue with a white stripe to indicate the higher performance class station cabling.

2. Backbone cables shall be labeled at each end.

   a. Provide additional cable labeling at each manhole and pull box.
   b. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.
   c. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Grounding/Bonding Labeling:

1. The PBB shall be labeled "PBB." There shall be only one PBB in the facility.
2. Label all TBB conductors connecting to the PBB with a unique label, located at both ends of the TBB.
3. Each SBB shall be labeled with a unique label.

3.2 ADMINISTRATION

A. Provide administrative documentation of cabling, termination hardware, termination positions, splices and grounding as described above.

B. Identifiers:

1. Cable Identifiers: Provide a unique identifier for each cable serving as a link to the cable record. The identifier shall be marked on the cable or on the cable label.
2. Termination Hardware Identifiers:

   a. Provide a unique identifier for each termination hardware unit, serving as a linkage the unit record.

3. Termination Position Identifiers:

   a. A unique identifier shall be provided to each termination position to serve as a link to the termination position record.
   b. An identifier shall be marked on each position label. Each termination position shall be marked with the termination position identifier.

4. Splice Enclosure Identifier:

   a. Provide a unique identifier for each splice enclosure to serve as a link to its record.

5. Grounding/Bonding Identifiers:

   a. The PBB shall be marked "PBB". Only one PBB shall be located in a facility.
   b. Provide a unique identifier for each TBB attached to the PBB.
   c. A unique identifier shall be provided for each SBB in a facility.
   d. Provide a unique identifier for each TBB attached to the SBB.

C. Records:

1. Cable Records: Provide cable identifier, cable type, conductor quantity, damaged conductor quantity, unterminated conductor quantity, available conductor quantity.

   a. The cable type field shall include the manufacturer and manufacturer's catalog designations, including ratings.
   b. Termination position linkage fields shall be included.

2. Termination Hardware Records: Provide hardware identifier, hardware type, damaged position numbers, available position numbers.

   a. Provide linkages to termination position records, space records, and grounding records.

3. Termination Position Records: Provide termination position identifier, cable conductor numbers.

   a. Provide linkages to cable records, termination position records, termination hardware records and space records.

4. Splice Records: Indicate the splice identifier and the type.

    a. Provide linkages to cable records and space records.

5. Grounding/Bonding Records:

    a. PBB Record: Provide PBB identifier, busbar type, grounding conductor identifier.

        1) Provide linkage to bonding conductor records and space records.

    b. TBB Records: Provide TBB identifier, conductor type, and busbar identifier.

        1) Provide linkage to busbar and pathway records.

END OF SECTION 27 05 53

SECTION 27 11 00 - COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for communication equipment rooms.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

B. Section 27 05 26 - Communications Bonding

C. Section 27 05 28 - Interior Communication Pathways

D. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for applicable standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT GROUNDING

A. Refer to specification section 27 05 26 for grounding requirements.

B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.2 EQUIPMENT RACKS AND CABINETS

A. Where identified on the drawings in Communication Equipment Rooms, equipment cabinets shall be furnished and installed by the Contractor to house cable termination components (e.g., copper, optical fiber) and network electronics.

B. The equipment rack shall conform to the following requirements:

1. Standard TIA/EIA 19" Wall Cabinet:

a. The equipment cabinets shall be constructed of painted steel or aluminum and offer a usable mounting height of 12 RU. Racks shall be a minimum of 18 inches deep. Access to the rear of the cabinet-mounted equipment shall be by a hinged arrangement.
b. The equipment cabinet shall be equipped with a lockable steel front door and furnished with two (2) keys that shall be usable on all cabinets furnished under this Contract.
c. The equipment cabinet shall be configured to allow for adjustment of the channel uprights (front to rear) in 1-inch increments and be spaced to accommodate industry standard 19-inch mounting. The cabinet shall be tapped to accept 12-24 screws.
d. The equipment cabinet shall be vented to allow for airflow through the cabinet.

2.3 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00.

C. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.4 OPTICAL FIBER PANELS

A. All terminated optical fibers shall be mated to simplex LC-type couplings mounted on enclosed fiber distribution cabinets. Couplings shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, FC, and MT-RJ by changing panels on which connector couplings are mounted.

B. The fiber distribution cabinet shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and drawings, including those not terminated (if applicable). Connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the Contractor.

C. The fiber distribution cabinet shall be an enclosed assembly affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to conceal and protect the optical fiber couplings, connectors, and cable.

D. Access to the inside of the fiber distribution cabinet's enclosure during installation shall be from the front and/or rear. Panels that require any disassembly of the fiber distribution cabinet to gain entry will not be accepted.

E. The fiber distribution cabinet's enclosure shall provide for strain relief of incoming optical fiber cables and shall incorporate radius control mechanisms to limit bending of the optical fiber to the manufacturer's recommended minimums or 1/2", whichever is larger.

F. All fiber distribution cabinets shall provide protection to both the "facilities" and "user" side of the coupling. The fiber distribution cabinet's enclosure shall be configured to require front access only when patching. The incoming optical fiber cables (e.g., backbone, riser, horizontal, etc.) shall not be accessible from the patching area of the panel. The fiber distribution cabinet's enclosure shall provide a physical barrier to access such optical fiber cables.

G. Where "Loose Buffered" cables are installed, the 250 um coated optical fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) the use of a "fan-out" kit. In the latter approach, individual fibers are to be secured in a protective covering, an Aramid (e.g., Kevlar) reinforced tube for example, with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.3 dB for multi-mode fibers. Direct termination of 250 um coated optical fibers shall not be permitted.

2.5 OPTICAL FIBER COUPLERS/ADAPTERS

A. Optical Fiber Couplings (LCtype) (Multimode/Singlemode):

1. LC-type optical fiber couplings shall be used to terminate optical fiber backbone cable on fiber distribution cabinet panels in communication equipment rooms. Horizontal optical fiber cables shall also be terminated using optical fiber couplings at their designated work area locations on information outlet faceplates for "fiber to the desk."
2. LC-type optical fiber couplings shall be snap-type with locking washer and nut.
3. LC-type optical fiber couplings shall incorporate domed zirconia ferrule and shall utilize a PC polish to ensure fiber-to-fiber physical contact for low loss and reflections.
4. LC-type optical fiber couplings shall accept 125-micron outside diameter multimode fiber.
5. The attenuation per mated pair shall not exceed 0.7 dB (individual) and 0.5 dB (average). Connectors shall sustain a minimum of 200 mating cycles per TIA/EIA-455-21 without violating specifications.

6. LC-type optical fiber couplings shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2 dB
Durability (FOTP-21)	0.2 dB
Impact (FOTP-2)	0.2 dB
Thermal Shock (FOTP-3)	0.2 dB
Humidity (FOTP-5)	0.2 dB

7. Performance Requirements:

   a. Length: 2 inches
   b. Operating Temperature: -40C to 85C

8. Basis of Design:

   a. Hubbell

2.6 TERMINATION BLOCKS

A. Where identified on the drawings in Communication Equipment Rooms, 110-type termination blocks shall be furnished and installed by the Contractor for termination of copper cable.

B. Each horizontal row of the 110-type termination block must be capable of terminating one (1) 25-pair binder group (backbone cables). Backbone and horizontal 110-type termination blocks shall be segregated, clearly identifying their function.

C. The Mechanical Termination Shall:

   1. Have the ability of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.
   2. Provide a direct connection between the cable and jumper wires.
   3. Have less than 0.2 dB of attenuation from 1-16 MHz.
   4. Have less than 100 mW of DC resistance.
   5. Have less than 5 mw of resistance imbalance.
   6. Have minimal signal impairments at all frequencies up to 16 MHz.

D. The 110-type termination block shall identify pair position by a color designation - Blue, Orange, Green, Brown and Slate (backbone only).

E. The 110-type termination block shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

2.7 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide 1/4" screw holes for wall mounting.

2.8 COPPER PATCH CORDS

A. 110-type Termination Block:

1. Provide Category 6 copper patch cords for each assigned port on the 110-type termination block. These patch cords shall be the cross-connect between the copper backbone 110-type termination block and the horizontal RJ-45 modular patch 110-type termination block. Copper patch cords shall be equipped with a 2-pair 110-type connector on the backbone end and a RJ-45 connector 2-pair 110-type on the horizontal cable end. Provide lengths as required by the layout of the room.
2. Refer to Section 27 15 00 for cable and connector performance requirements.
3. Patch cords shall not be made-up in the field.
4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):

    a. Hubbell 2-Pair 110 t0 RJ-45

B. Modular Patch Panel:

1. Provide Category 6 copper patch cords for 50% of all assigned ports on the modular patch panel. Of these cords, 60% shall be 3' in length and 40% shall be 5' in length. These patch cords shall be the cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 4-pair RJ-45 connector on each end.
2. Refer to Section 27 15 00 for cable and connector performance requirements.
3. Patch cords shall not be made-up in the field.
4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):

    a. Hubbell HC Series

2.9 FIBER PATCH CORDS

A. Optical Fiber Patch Cords (Multimode):

1. Provide 50/125 mm multimode (MM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Government's network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped LC-type connector on each end and shall be a minimum of 5 feet in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans.
2. Channels shall be of equal length.
3. Refer to Section 27 15 00 for cable and connector performance requirements.
4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):

    a. Hubbell DFPC Series

2.10 LIGHTNING PROTECTION

A. Contractor shall provide multipair protector panel(s), including mounting and termination hardware. The multipair protector panel(s) shall be UL listed.

B. For small pair count applications (less than or equal to 200-pairs), the multipair protector panel shall consist of a mounting panel for a series of solid-state protector units, 710-type connector for input, and 110-type termination blocks for output. Insertion of the protector units into the mounting panel will complete the circuit. The multipair protector panel(s) shall be available in 25-, 50-, 100-, and 200-pair counts.

C. Solid State Protection Units:

1. DC Breakdown Voltage (at 2 kV/sec): 220-300V.
2. Surger Breakdown Voltage (at 100 V/usec): 220-300V.
3. Insulation Resistance: Greater than 100 M W typical.
4. DC Holdover Current: 260 mA/52V, 200 mA/135V, 140 mA/150V.
5. Capacitance: Less than 100 pF.
6. Rated Impulse Discharge: 200A.
7. On-state Voltage (at 100A): Less than 10V.
8. Response Time: Less than 100 nsec.
9. Line Series Resistance: Less than 4 W
10. Sneak Current Operation (heat coils): 540 mA = Less than 210 sec; 1A = Less than 15 sec

PART 3 - EXECUTION

3.1 D-RINGS

A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.

B. Locate D-rings on 24" centers vertically and horizontally.

C. Securely attach D-rings to the wall as required by the manufacturer.

3.2 GROUNDING

A. Provide a complete grounding system in accordance with the requirements of Section 27 05 26.

3.3 CROSS CONNECT INSTALLATION

A. Bend radius of cable shall not exceed 4 times the outside cable diameter or manufacturer's recommendation, whichever is less.

B. Cables shall be neatly bundled and dressed to their respective panels and/or blocks. Each shall be fed by an individual bundle separated and dressed to the point of cable entrance into the rack and/or frame.

C. The cable jacket shall be maintained as close as possible to the termination point.

D. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that is visible without removing the bundle support.

3.4 OPTICAL FIBER TERMINATION

A. All fiber slack shall be neatly coiled within fiber splice enclosures or splice trays. No slack loops shall be allowed external to the enclosure.

B. Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cable strength member shall be securely attached to the cable strain relief bracket in the enclosure.

C. Each cable shall be clearly labeled at the entrance to all enclosures.

D. A maximum of 12 strands shall be spliced in any tray.

3.5 CONDUITS AND CABLE ROUTING

A. Refer to Section 26 05 33 for additional requirements.

B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents.

C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.

D. All conduits shall be reamed and shall be installed with a nylon bushing.

E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION 27 11 00

SECTION 27 13 00 - BACKBONE CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing backbone communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of both optical fiber and/or copper cabling.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Technology Systems Requirements.

B. Section 27 15 00 - Horizontal Cabling Requirements.

C. Section 27 17 20 - Structured Cabling System Warranty.

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. The basis of design is listed herein. Refer to Section 27 17 20 for additional acceptable manufacturers.

2.2 OPTICAL FIBER BACKBONE - INSIDE PLANT

A. Multimode (MM):

1. This optical fiber backbone cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.

2. Optical fiber cable materials shall be all dielectric (no conductive material).
3. Optical fiber cable shall carry an OFNP (optical fiber non-conductive plenum) rating. Refer to Section 27 05 00 for project requirements.
4. Optical fiber cable shall be interlocking armored cable.
5. Outer Sheath: The outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.
6. Temperature Range:

    a. Storage: -40C to +70C (no irreversible change in attenuation).
    b. Operating: -40C to +70C.

7. Humidity Range: 0% to 100%.
8. Maximum Tensile Strength (greater than or equal to 12 fibers):

    a. During Installation: 1332 N (300 lb. force) (no irreversible change in attenuation).
    b. Long-Term: 600 N (135 lb. force).

9. Maximum Tensile Strength (less than or equal to 6 fibers):

    a. During Installation: 1000 N (225 lb. force) (no irreversible change in attenuation).
    b. Long-Term: 100 N (67 lb. force).

10. Bending Radius:

    a. During Installation: 20 times cable diameter.
    b. No Load: 10 times cable diameter.

B. Optical fiber cables suitable for installation in multiple environments (e.g., underground duct and building risers) may be used at the Contractor's option. Such optical fiber cables shall meet all specifications noted above for cables designated for each environment through which the optical fiber cable shall pass.

C. Basis of Design (OM4 Multimode):

1. Hubbell OM4 (HFCD15xxx series).
2. Additional acceptable manufacturers.

    a. Corning

2.3 COPPER BACKBONE - INSIDE PLANT

A. CAT 3 Backbone Cable:

1. The CAT 3 backbone cable shall link Communication Equipment Rooms serving the building. These CAT 3 backbone cables shall be terminated on 110-type termination blocks.
2. CAT 3 backbone cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride (PVC) CMR or thermoplastic CMP plenum rated skin. Refer to Section 27 05 00 for project requirements. Conductors shall be twisted to form pairs and be fully color-coded.
3. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of 10 distinctive colors to identify 25-pairs in accordance with ICEA publication S-80-576-1988. Marking of each mate of the primary conductor in a pair with the color of that primary conductor is optional.

4. CAT 3 backbone cable shall meet the TIA/EIA Category 3 performance requirements.
5. When CAT 3 backbone cables of larger than 25-pairs are required, the core shall be assembled into 25-pair sub-units, each color-coded in accordance with ICEA publication S-80-576-1988. CAT 3 backbone cables with over 600-pair shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.
6. CAT 3 backbone cables shall contain an overall corrugated, coated aluminum shield that is electrically continuous over its entire length.
7. CAT 3 backbone cables shall be Air Core with an 8-mil ALVYN Sheath.
8. Basis of Design:

    a. Belden

    b. Additional acceptable manufactures

        1) Mohawk
        2) Berk-Tek
        3) Superior Essex

2.4 OPTICAL FIBER CONNECTORS

A. Optical Fiber Pigtails (Multimode):

1. Single-fiber fiber optic pigtails shall be constructed from 50/125 um multimode (MM) optical fiber of the same grade as the multimode fiber optic backbone cable utilizing tight buffer construction.
2. Fiber optic pigtails shall be factory terminated with a ceramic tipped LC-type connector on one end and shall be a minimum of 5 feet (1.5m) in length or as indicated on the drawings. Channels shall be of equal length.
3. Connector body shall be of materials similar to that used in the proposed couplings. Refer to Section 27 15 00 for connector performance requirements.
4. Provide in quantity to terminate all backbone fiber optic cable strands on each end.
5. Basis of Design:

    a. Multimode Optical Fiber Pigtails shall be from the same manufacturer as used for the fiber optic termination equipment.

B. Optical Fiber Connectors (LC-type) (Multimode):

1. LC-type Optical Fiber Connectors: Shall be used to terminate optical fiber in communication equipment rooms.
2. LC-type optical fiber connector plugs shall be snap-type with an integrated pull-proof design.
3. LC-type optical fiber connector plugs shall incorporate a zirconium ceramic ferrule and shall utilize a factory pre-polish end face to ensure fiber-to-fiber physical contact for low loss and reflections.
4. LC-type optical fiber connector plugs shall accept 1.6mm - 2.0mm and 3.0mm outside diameter fiber.
5. The average insertion loss is 0.3db for multimode and single mode connectors

6. LC-type optical fiber connector plugs shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2dB
Durability (FOTP-21)	0.2dB
Impact (FOTP-2)	0.2dB
Thermal Shock (FOTP-3)	0.2dB
Humidity (FOTP-5)	0.2dB

7. Additional Performance Requirements:

   a. Length: 2.23 inches
   b. Operating Temperature: -40C to 85C

8. Basis of Design:

   a. Optical fiber connectors shall be from the same manufacturer as fiber cable manufacturer.

2.5 OPTICAL FIBER BACKBONE PERFORMANCE

A. Multimode (MM):

1. Fiber Type: Multimode; doped silica core surrounded by a concentric glass cladding.
2. Index Profile: Graded Index.
3. Transmission Windows: 850-nm and 1300-nm.
4. Core Diameter (nom): 50-um (microns) Less than or equal to 2.5.
5. Cladding Diameter: 125-um ± 1.
6. Core-clad Concentricity: Less than or equal to 1.0-um.
7. Cladding Non-circularity: Less than or equal to 1.0%.
8. Fiber Coating Diameter:

   a. 245-um ± 10 (primary coating).
   b. 900-um (nominal) secondary coating (tight buffer)
   c. All coatings shall be mechanically strippable without damaging the optical fiber.

9. Attenuation (maximum @ 23 ± 5C; backbone):

   a. @ 850-nm: 3.5 dB/km.
   b. @ 1300-nm: 1.5 dB/km.
   c. @ 1300-nm thru 1380-nm: 1.0dB/km

      1) When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the optical cable shall not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.

10. Bandwidth (minimum):

    a. @ 850-nm: 4700 MHz*km. (OM4)

11. No optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Government.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 5 meters (approximately 15 feet) of slack cable (each cable if applicable) shall be coiled and secured at both ends located in the entrance room, telecommunications room or main equipment room, for backbone and intra-building cable.

C. Where exposed, all backbone fiber optic cable shall be installed in protective inner duct. This includes areas where the cable is routed in cable tray and where making a transition between paths (e.g., between conduit and cable tray or into equipment racks). The inner duct should extend into the termination and/or storage enclosure(s) at system endpoints.

3.2 CROSS-CONNECTS

A. The Government will be responsible for all cross-connects between the data backbone cabling and network electronics and between the data network electronics and horizontal cabling.

B. The Contractor shall be responsible for the cross-connect wiring between the horizontal and backbone voice cabling.

1. All four (4) pairs of the horizontal cable shall be terminated on modular patch panels. Two (2) pairs of the horizontal cable shall be cross-connected to the backbone cable. Refer to the drawings for requirements of the 110 to RJ-45 cross connect cable.
2. All four (4) pairs in each horizontal cable shall be terminated on 110-type termination blocks in a field dedicated for horizontal cabling. Two (2) pairs of the horizontal cable shall be cross-connected to the backbone cable. 2-pair cross-connect wire, color-coded to identify each pair, shall be used. The 25TH pair position (50th, 75th, etc.) of each riser voice block shall remain vacant.
3. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Avaya 88A retainer clips (or equivalent) shall be used on each 110-type termination block to secure jumper wires on the wiring block(s).

C. This Contractor shall be responsible for cross-connects between the cabling terminations at the entrance room and the telephone utility network point-of-presence. It shall be the responsibility of the Contractor, to work with the Government and provide the necessary assistance to allow Government and/or telephone company personnel to make the necessary connections to establish service on the new cable system. These activities include, but are not limited to cross-connect documentation, general wiring overview and cable pair identification.

END OF SECTION 27 13 00

SECTION 27 15 00 - HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

B. Section 27 17 20 - Structured Cabling System Warranty

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards and plenum cable requirements.

B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).

C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.

D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

A. CAT 6 Cable:

1. The horizontal cable requirements must be met, as well as the following channel requirements.
2. CAT 6 cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.
3. Performance tests shall be conducted using swept frequency testing through 250 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 250 MHz is not acceptable.
4. Performance data shall be characterized as "Guaranteed Headroom" and shall be guaranteed by the manufacturer to perform at guaranteed margins over ANSI/TIA/EIA-568-C.2. Performance data that is not warranted by the manufacturer will not be considered.
5. The structured cabling and connectivity must be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed below. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
6. The 4-connector channel performance margins listed in the below criteria shall be guaranteed minimum margins above ANSI/TIA/EIA-568-C.2 with electrical parameters between 1-250 MHz.

    a. Insertion Loss: 5%
    b. NEXT: 3.0 dB
    c. PS NEXT: 5.0 dB
    d. ACR-F (ELFEXT): 4.0 dB
    e. PS ACR-F (PS ELFEXT): 5.0 dB
    f. Return Loss: 2 dB

7. The jacket color for CAT 6 cable shall be white for voice applications and blue for data applications.
8. Basis of Design:

    a. Hubbell C6RP Series
    b. Additional acceptable manufacturers:

        1) Belden
        2) Commscope/Uniprise

9. Manufacturer:

    a. Hubbell C6RP Series
    b. No exceptions allowed

2.2 CONNECTORS/COUPLERS/ADAPTERS

A. Refer to Section 27 11 00 for requirements and 27 13 00 for requirements.

2.3 FACEPLATES/JACKS

A. CAT 6 Jacks:

1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.
3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.
7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall:

    a. Match the receptacle color used for other utilities in the building, or
    b. When installed in surface raceway (if applicable), match the color of that raceway.

8. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:

    a. Be a low-profile assembly.
    b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
    c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.
    d. Incorporate a shroud that protects the optical fiber couplings from impact damage.

9. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
10. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
11. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
12. CAT 6 modular jacks shall be pinned per TIA-568B.

13. CAT 6 termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:

    a. ANSI/TIA/EIA-568-A-5
    b. ANSI/TIA/EIA-568A
    c. ISO/IEC 11801
    d. IEC 603-7
    e. FCC PART 68 SUBPART F

14. The color for CAT 6 jacks shall be white for voice applications and blue for data applications. Alternately, a color-coded bezel or icon may be used to identify the CAT 6 modular jack.

2.4 COPPER WORK AREA CORDS

A. RJ-45:

1. Provide the same quantity of Category 6 copper work area cords as copper patch panel cords specified in Section 27 11 00. Copper work area cords shall be equipped with an 8-pin modular RJ-45 connector on each end.
2. Work area cords shall be 10' in length.
3. Manufacturer of copper patch cable shall be the same as the manufacturer of the horizontal copper cable.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.
2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. <u>The use of plastic cable ties is strictly prohibited</u>.
6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
8. Cabling shall not be routed through wall(s) without a pathway. Provide conduit sleeve pathways through wall(s) for proper installation of horizontal cabling.

B. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

1. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:

   a. Twelve (12) inches from power lines of less than 5-kVa.
   b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
   c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
   d. Thirty-nine (39) inches from transformers and motors.

2. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

3.2 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Data UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.
2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.
3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION 27 15 00

SECTION 27 17 10 - TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work, the Contractor shall submit:

1. Complete information on testing procedure as described herein.
2. Test plan summary for each cable type to be tested including equipment to be used, setup, test frequencies or wavelengths, results format, etc.

PART 2 - PRODUCTS

2.1 TESTING COPPER

A. General Requirements:

1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
4. Conduct acceptance testing according to a schedule coordinated with the Government/Architect/Engineer. Representatives of the Government may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.
7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

    a. CAT 3 Cable:

        1) Indoor/Backbone Cable:

            a) Backbone CAT 3 copper cable shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the termination blocks (e.g., 110). Any mis-positioned pairs must be identified and corrected. The percentage of "bad" pairs shall not exceed 3% in any backbone (riser or tie) cable based on total pair count. All bad pairs must be identified and documented.

    b. CAT 6 Cable:

        1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
        2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
        3) CAT 6 horizontal cable shall be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link", including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:

            a) Wire Map
            b) Length
            c) NEXT Loss (Pair-to-Pair)
            d) NEXT (Power Sum)
            e) ELFEXT (Pair-to-Pair)
            f) ELFEXT (Power Sum)
            g) Return Loss
            h) Attenuation
            i) Propagation Delay
            j) Delay Skew

        4) The maximum length of horizontal cable shall not exceed 295 feet, which allows 33 feet for technology equipment and modular patch cords.

5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.
7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

2.2 TESTING FIBER

A. General Requirements:

1. Perform acceptance tests as indicated below for each optical fiber sub-system (e.g., backbone, .) as it is completed.
2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
3. Visually inspect all optical fiber cabling and termination points to ensure that they are complete and conform to the standards defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
4. Conduct acceptance testing according to a schedule coordinated with the Government/Architect/Engineer. Representatives of the Government may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove that the optical fiber connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results.
7. All optical fiber cabling shall be 100% fault-free unless noted otherwise. If any optical fiber cable is found to be outside the specification defined herein, that optical fiber cable and the associated connector(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

9. The optical fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Government, provide cable manufacturer's test report for each reel of cable provided. These test reports shall include manufacturer's on-reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.

    a. On-the-reel bandwidth performance as tested at the factory. Factory data shall be provided upon request.
    b. The testing noted for optical fiber cabling utilizes an Optical Time Domain Reflectometer (OTDR). However, the Contractor may submit to the Architect/Engineer for pre-approval of alternate fiber optic testing equipment.

B. Tests Prior to Installation: The Contractor, at their discretion and at no cost to the Government, may perform an attenuation test with an OTDR at 850-nm or 1300-nm on each optical fiber of each cable reel prior to installation. Supply this test data to the Architect/Engineer prior to installation.

C. Tests After Installation: Upon completion of cable installation and termination, the optical fiber cabling shall be tested to include:

1. Optical Attenuation ("Insertion Loss" Method):

    a. Optical Attenuation shall be measured on all terminated optical fibers in one direction of transmission using the "Insertion Loss" method measurement in accordance with the TIA/EIA 526-14, Method B, and be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made. Multimode optical fibers shall be tested at 850 ±± 30 nm. Singlemode optical fibers (if applicable) shall be tested at 1300 ±± 20 nm.
    b. Attenuation of optical fibers shall not exceed the values calculated as follows:

        1) Attenuation (max.) = 2*C+L*F+S dB.
        2) Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers), and F is the maximum allowable optical fiber loss (in dB/km). S is the total splice loss (# of splices * maximum attenuation per splice).

2. Verification of Link Integrity (OTDR):

    a. All optical fibers shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multimode optical fibers shall be tested at 850-nm and 1300-nm (nominal). Singlemode optical fibers (if applicable) shall be tested at 1310-nm and 1550-nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used. Access jumpers used for testing shall match the type and core diameter of the fiber optic strand under test.
    b. Set OTDR's test variables to the manufacturer's published backscatter coefficient and velocity of propagation figure for the specific strand of fiber under test. OTDR's range should be set to approximately 1.5 times the length of the strand under test, pulse width should be optimized for the length of the fiber optic strand under test, and number of averages should be adjusted to approximately 120 seconds per wavelength.

c. OTDR traces revealing a point discontinuity greater than 0.2 dB in a multimode optical fiber or 0.1 dB in a singlemode optical fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that optical fiber by the Government. The installation of that optical fiber cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that optical fiber cable and the associated terminations shall be replaced at the expense of the Contractor.

2.3 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms, shall become the property of the Government.
3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Government.

B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (USB thumb drive). The thumb drive shall contain the electronic equivalent of the test results as defined by the bid specification and be in the tester's native format as well as summaries of each test in pdf format. Provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. Furnish one (1) copy of the data and display (if applicable) software.

C. Optical Fiber Media Test Data:

1. Test results shall include a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
2. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to the Architect/Engineer in electronic form for review. Trace files shall be so named as to identify each individual optical fiber by location in the cable system and optical fiber number or color. Where traces are provided in electronic form, provide along with the above documentation, one (1) licensed copy of software that will allow for the display of OTDR traces provided. The software shall run on a Microsoft Windows-based personal computer.

D. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION (Not Used)

END OF SECTION 27 17 10

SECTION 27 17 20 - STRUCTURED CABLING SYSTEM WARRANTY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Technology Systems Requirements.

B. Section 27 11 00 - Communication Equipment Room (CER).

C. Section 27 13 00 - Backbone Cabling Requirements.

D. Section 27 15 00 Horizontal Cabling Requirements.

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to close of the project the Contractor shall submit:

1. A numbered certificate from the manufacturing company registering the installation.

PART 2 - PRODUCTS

2.1 WARRANTY

A. A twenty (20) year Product Installation Warranty shall be provided for the structured cabling system as described in the contract documents.

B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).

C. The system assurance warranty shall cover the failure of the wiring system to support the application it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the TIA/EIA 568A component and link/channel specifications for cabling.

D. Upon successful completion of the installation and subsequent inspection, the Government shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION

3.1 WARRANTY REQUIREMENTS

A. This Contractor shall be responsible for providing, installing and testing a structured cabling system that will meet the manufacturer's warranty requirements.

END OF SECTION 27 17 20

SECTION 27 51 13 - PAGING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ceiling Speaker

B. Paging System Cable

1.2 RELATED WORK

A. Section 26 05 33 - Conduit and Boxes

B. Section 26 05 35 - Surface Raceways

C. Section 26 05 13 - Wire and Cable

D. Section 27 05 00 - Basic Communications Systems Requirements

E. Section 27 05 03 - Through Penetration Firestopping

F. Section 27 05 28 - Interior Communication Pathways

G. Section 27 15 00 - Horizontal Cabling Requirements

H. Section 27 05 53 - Identification for Communication Systems

1.3 QUALITY ASSURANCE

A. Manufacturer: The manufacturer shall have five (5) years documented experience in the design and manufacture of paging system devices and equipment.

B. Installer: The Contractor shall have a minimum of three (3) years documented experience in paging system installation and must be a factory-authorized service and support company specializing in the selected manufacturer's product, with demonstrated prior experience with the selected manufacturer's system installation and programming.

1. The Contractor shall own and maintain all tools and equipment necessary for successful installation and testing of the system and have personnel adequately trained in the use of such tools and equipment.

C. The following qualifications have been endorsed by the AudioVisual and Integrated Experience Association (AVIXA), which is formerly known as InfoComm International.

1. The Contractor shall obtain the services of a Certified Technology Specialist with a specialized installation endorsement (CTS-I).

2. The CTS-I shall perform the following tasks on the project:

    a. Review contractor's submittals and provide a letter stating the submittals are in compliance with the contract documents.
    b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every 2 weeks during the construction period.
    c. Provide a final written and dated confirmation of a final construction review prior to testing.
    d. Review final testing and calibration of the systems and provide a letter with the documented results or transmittal of the results stating the test results and calibration compliance with the contract documents.

D. Audio System Programmer: All digital signal processing equipment (DSP) used on the project shall be setup, programmed, and calibrated by a factory-trained and certified technician.

E. The Contractor shall have acquired and maintained all certifications for a minimum of one (1) month prior to the posted bid date of this project.

F. Service: The installer must be factory certified to provide service on the installed manufacturer's equipment and must have local service representatives within 100.

G. The entire installation shall comply with all applicable electrical and safety codes. All applicable devices, equipment, and cabling shall be listed by Underwriters' Laboratories, Inc.

1.4 REFERENCES

A. ADA - Americans with Disabilities Act

B. ADAAG - Americans with Disabilities Accessibility Guidelines

C. NFPA 70 (NEC) – National Electrical Code

D. UL 813 - Standards for Commercial Audio Systems

E. UL 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use

F. Code of Federal Regulations Title 29 Subtitle B Chapter XVII Part 1910 Subpart L Section 1910.165 - Employee Alarm Systems

G. 2022 FGI Guidelines 2.1-8.5.1.1 (7) - Acoustics Considerations

H. Illinois Administrative Code Title 77 Chapter I Subchapter b Part 250 Section 250.2500 - Electrical Requirements

1.5 SUBMITTALS

A. Submit product data under the provisions of Section 27 05 00.

B. Provide materials documenting experience requirements of the manufacturer and installing contractor.

C. Product Data Submittal: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item by item.
2. All component options and accessories specific to this project.
3. Electrical power consumption rating and voltage.
4. Heat generation for all power consuming devices.
5. Wiring and connection requirements.
6. Manufacturer's installation instructions, indicating application conditions and limitations of use as stipulated by product testing agency and instructions for storage, handling, protection, examination, preparation, installation, and initiating usage of product.

D. Certification Documentation Submittal:

1. Provide documentation of all required certifications. All certifications shall be current and valid. Any certificate with expired dates will not be accepted. Submittal shall include documentation of the following:

a. System Equipment Manufacturer(s) dealer certification(s) and dealer number(s).
b. System Equipment Manufacturer(s) programmer certification(s).
c. All other applicable dealer, installation, and programming certifications.

2. If an alternate manufacturer is submitted, the equivalent certifications to the basis of design manufacturer's shall be required and submitted.

E. Provide voltage drop calculations for each speaker cable circuit or run, showing the drop for the specific circuit or run wattage and cable size used.

F. Quality Assurance:

1. Provide list of test equipment proposed for use in testing the installed paging system.
2. Provide system checkout test procedure to be performed at acceptance, including demonstration of specified performance and all required system features and functions listed herein and as further detailed on the drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 27 05 00.

B. Store and protect products under the provisions of Section 27 05 00.

1.7 SYSTEM DESCRIPTION

A. This specification section describes the furnishing, installation, commissioning and programming of an existing complete, turnkey single-zone paging system.

B. Performance Statement: This specification section and the accompanying design documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed or every equipment connection that must be made. Based on the equipment constraints described and the performance required of the system as presented in these documents, the vendor and the Contractor are solely responsible for determining all wiring, programming, and miscellaneous equipment required for a complete and operational system.

C. This Contractor shall furnish and install a paging system as hereinafter specified and further detailed on the drawings. System shall be completely wired and ready for use including, but not limited to, outlet boxes, conduit, wire, equipment, speakers, controls, and equipment cabinets.

D. Basic System Requirements: The system shall be capable of providing the following minimum features in addition to those specified elsewhere in this specification and on the drawings:

1. Single-zone.

1.8 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 05 00.

B. Provide floor plans identifying actual locations of all installed overhead paging system equipment and devices.

C. Provide final system block diagram showing any deviations from shop drawing submittal. Block diagram shall include cable number documenting the numbers installed on both ends of the cable in the field.

D. Provide documentation of all test results and statement that system checkout test, as outlined in shop drawing submittal, is complete and satisfactory.

E. Warranty: Submit written warranty and complete all Government registration forms.

F. Complete all operation and maintenance manuals as described herein.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit data under provisions of Section 27 05 00.

B. Operation and Maintenance data shall be submitted in hard copy and electronic .pdf format.

C. Operation data shall include:

1. Manufacturer's full operation instructions for each piece of equipment.
2. Complete documentation of all settings and programming.
3. Detailed, step-by-step instructions for system operation, including accessing, initiating, and performing all required system features and functions listed herein.

D. Maintenance data shall include:

1. Description of servicing procedures:

a. Documentation of all manufacturers' recommended preventive and remedial maintenance procedures to be performed by the Government.
b. Troubleshooting flowcharts.

1.10 WARRANTY

A. Unless otherwise noted, provide warranty for a minimum of one (1) year after Substantial Completion, as defined by the Contract. Certain system components may require additional manufacturer's warranty as described herein.

B. The warranty shall:

1. Cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).
2. Include emergency service and repair on-site, with response times of 24 hours from time of notification. The system shall be repaired and restored to operation within 24 hours of technician's arrival on site.

C. Refer to the individual product sections for further warranty requirements of individual system components.

PART 2 - PRODUCTS

2.1 CEILING SPEAKER

A. Features:

1. Integral 70-volt transformer
2. Circular paintable steel grille

B. Provide complete with manufacturer's circular paintable steel speaker enclosure and T-bar support tile bridge.

C. Refer to the drawings for manufacturer and part number.

2.2 PAGING SYSTEM CABLE

A. Refer to Section 27 05 00 for plenum cable rating requirements.

B. Speaker Cable

1. Minimum 18/2 shielded with drain wire

a. Conductor Type: Bare copper, stranded

2. Cable shall be NEC compliant and UL listed.
3. Basis of Design:

    a. Belden 5300FE (CM) or 6300FE (CMP)

4. Provide with larger-gauge conductors where necessary to maintain acceptable voltage drop as defined herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all manufacturer's instructions and recommendations for installation of all equipment, devices, and materials.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. Wiring:

1. Refer to Division 26 for conduit requirements and additional wiring requirements. Wiring not installed in conduit shall be plenum rated.
2. All cabling shall be run in conduit "free-air" in non-continuous cable supports above accessible ceilings, and in conduit or in a secured metal raceway in exposed areas. Supports shall be spaced at a maximum 4-foot interval. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.
3. All overhead paging system audio cabling, including but not limited to speaker, line-level audio, and microphone-level audio cabling, shall be installed in its own cable pathway and shall not share any raceway or cable pathway with telephone or computer network cabling or cabling of any other system.

    a. Cable shall not be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires. Cables shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, ceiling supports, electrical or communications conduit, or structural elements.
4. Manufacturer's minimum bend radius specifications for cables shall be observed in all instances.
5. All cable shall be installed at right angles and be kept clear of work by other trades. To reduce or eliminate EMI, the following minimum separation distances from £ 480V power lines shall be adhered to:

    a. 12 inches from power lines of 5-kVa
    b. 18 inches from high voltage lighting (including fluorescent)
    c. 39 inches from power lines of 5-kVa or greater
    d. 39 inches from transformers and motors

6. It shall be noted that all cables shall be installed in continuous lengths from endpoint to endpoint. No splices shall be allowed unless noted otherwise.
7. All cable shall be free of tension at both ends.

8. Both ends of all cables shall be clearly labeled with an alphanumeric identifier. On speaker cables, the label shall indicate the speaker cable circuit zone or run and the telecommunications room in which the zone or run initiates; on line-level cables, the label shall indicate the signal and signal source. Record all speaker cable identifiers on record drawings.
9. No acid core or other corrosive flux solder shall be used in this system.
10. Speaker cable conductor sizes listed are minimum requirements. Actual wire size required shall be determined by the Contractor to maintain a maximum of 10% voltage drop or 0.5 dB insertion loss on any speaker zone. Actual speaker cabling installed shall meet or exceed minimum conductor sizes listed. Basis of design paging speaker cable listed herein is provided to list the minimum criteria and performance requirements for paging speaker cable.
11. The polarity of all cabling shall remain consistent throughout the project, on all equipment.
12. Do not run unbalanced audio signals over cables longer than 10 feet. Contractor shall provide a shielded transformer-based converter at signal source to convert the unbalanced signal to a balanced signal.
13. The Contractor shall provide an isolation transformer for any balanced or unbalanced audio line that exhibits hum, EMI / RFI, power line noise, or ground loops.
14. Provide all system wiring between all components as shown on project documents, as directed by the manufacturer, and/or required for proper system operation and to provide specified system functionality.

D. Equipment:

1. All necessary devices, sub-components, accessories, and incidental materials required to provide a complete, turn-key paging system that provides specified performance and all required system features and functions listed herein and as further detailed on the drawings shall be provided and installed as part of a complete system.
2. All speakers shall be connected in proper polarity.
3. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tools recommended by the manufacturer for that purpose. Use caution to avoid stripping or damaging connectors, terminals, or equipment by over-tightening termination fasteners.
4. The conductor color code used in terminating system cabling at system equipment and devices shall remain consistent from device to device for each unique device type throughout the project.

3.2 FIELD QUALITY CONTROL

A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications, as supplied and warranted by the system vendor. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system vendor.

B. Furnished products shall be listed and classified by UL as suitable for purpose specified and indicated.

C. Periodic observations will be performed during construction to verify compliance with the requirements of the project documents. These services do not relieve the Contractor of responsibility for compliance with the project documents.

3.3 SYSTEM SETUP, PROGRAMMING, AND ADJUSTMENT

A. The Contractor shall provide all system programming, startup, balancing, tuning, and adjustment required as part of this project. This shall include all calibration and adjustments of equipment controls, troubleshooting, and final adjustments that may be required.

B. Complete all necessary programming to provide the indicated functionality.

C. Paging system shall be adjusted to provide 70 dBA of sound measured at one (1) meter from each speaker when voice pages are made. Sound shall be clear, even, and undistorted and free of any hum, noise, or sonic anomalies. Where speakers are controlled via local volume controls, adjustments shall be made with the volume control set at 70

D. Paging system zone output equalization shall be adjusted to achieve +/- 3 dB over entire published effective frequency range of installed speakers, measured on axis at a distance of 1 meter from 10% of each speaker type installed +/- 4 dB over the 2,000 Hz octave band throughout all corridors, open treatment areas, and public spaces. All efforts shall be made to adjust the audible system output's average frequency response in all areas covered by each speaker zone to be as equal as possible when measured at ISO R 266-1997 / ANSI S1.6-1984 1/3 octave preferred frequencies from 20 Hz to 20 KHz.

3.4 TESTING

A. The Contractor shall conduct all system testing as part of the requirements of this project. This shall include all calibration and adjustments of equipment controls, troubleshooting, and final adjustments or corrective action that may be required to provide a complete system that provides the specified performance and all required system features and functions listed herein and as further detailed on the drawings.

B. At a minimum, the installer shall perform the following inspections and tests of the installed overhead paging system:

1. Verify that all features and functionality are operating properly.
2. Verify that the system receives signal from all sources and routes those signals as specified.
3. Verify that priority override hierarchy functions properly and according to the hierarchy specified.
4. Verify that system output meets specified sound level at each speaker.
5. Verify that system output meets specified minimum STI and/or CIS rating at representative points within all areas of coverage.
6. Verify that system output meets specified equalization requirements in all coverage areas.
7. Verify that all controls are properly labeled and interconnecting wires and terminals are identified.

C. Document all test results and submit as part of final system documentation package.

END OF SECTION 27 51 13

SECTION 28 05 00 - BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make the portion of the security systems a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Description of systems include but are not limited to the following:

1. Electronic access control system
2. Fire detection and alarm.
3. Low voltage security wiring (less than +120VAC) as specified and required for proper system control and communications.
4. Firestopping of penetrations of fire-rated construction as described in Section 28 05 03.

1.3 WORK SEQUENCE

A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Government, shall be scheduled with the Government. It may be necessary to schedule such work during non-occupied hours. The Government shall reserve the right to set policy as to when restricted construction hours will be required.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

   a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
   b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
   c. Technology trades shall include, but are not limited to, technology equipment, , conduit 1.5" and larger, , pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
   d. Maintenance clearances and code-required dedicated space shall be included.
   e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Government.

   a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.

3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Government.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).
      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Government's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Government's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Government.

10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.
3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.
5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

    a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.

6. Conform to all requirements of the City of Des Moines, IA Codes, Laws, Ordinances and other regulations having jurisdiction.
7. Conform to all published standards of USDA.
8. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
9. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.

10. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting clarification. If there is insufficient time to follow this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
11. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
12. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Government.

B. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Government or authorized independent agency/consultant.
7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)

    a. Factory Mutual
    b. Underwriters' Laboratories, Inc.

C. Examination of Drawings:

1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Government.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

D. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
4. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
6. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

E. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.6 WEB-BASED PROJECT SOFTWARE

A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.

B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.

C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.

D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
28 13 00	Electronic Access Control

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
   b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
b. The Contractor shall clearly indicate the size, finish, material, etc.
c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Government if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Government or other contractors.

    a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.

16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. Submittal file name: 28 XX XX.description.YYYYMMDD
    b. Transmittal file name: 28 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.

B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.

C. Change order work shall not proceed until authorized.

1.9 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.11 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Government.

1.12 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Government or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.13 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.14 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 28 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Government may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Government a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of this section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
2. Submitted bound copies of approved shop drawings.
3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.
4. Submitted a report stating the instructions given to the Government's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Government's representative as having received the instructions.
5. Submitted testing reports for all systems requiring final testing as described herein.
6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Government's possession prior to Government's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div28.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Government with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Government's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Government's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Government's representative so a representative can be present if desired.

D. Refer to the individual specification sections for minimum hours of instruction time for each system.

E. Operating Instructions:

1. The Contractor is responsible for all instructions to the Government and/or Government's operating staff on the security systems.
2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, the Contractor shall include in the bid an adequate amount to reimburse the Government for the Architect/Engineer to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Government on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Government for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. Record actual routing of all conduits sized 2" or larger.

E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Government's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

END OF SECTION 28 05 00

SECTION 28 13 00 - ELECTRONIC ACCESS CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Portal Devices

1.2 RELATED WORK

A. Section 08 71 00 - Door Hardware

B. Section 26 05 13 - Wire and Cable

C. Section 26 05 33 - Conduits and Boxes

D. Section 26 05 35 - Surface Raceways

E. Section 27 05 26 - Communications Bonding

F. Section 27 05 28 - Interior Communication Pathways

G. Section 27 05 53 - Identification for Communication Systems

H. Section 27 15 00 - Horizontal Cabling Requirements

I. Section 28 05 00 - Basic Electronic Safety and Security System Requirements.

J. Section 27 05 03 - Through Penetration Fire stopping.

1.3 QUALITY ASSURANCE

A. Manufacturer: The manufacturer shall have a minimum of ten (10) years documented experience in the development and manufacture of access control software and hardware. The software developer shall be, at a minimum, a Microsoft Silver Certified Integrator and Partner for those systems that reside in a Microsoft environment.

B. Contractor:

1. Shall be a factory-authorized installation, service and support company specializing in the selected manufacturer's product, with demonstrated prior experience of a minimum of three (3) years installing, programming and supporting the selected manufacturer's system.
2. Shall have been in business for a minimum of three (3) years and shall have installed a minimum of three (3) similar or larger sized systems. Contractor shall have a minimum of two (2) service technicians who are certified in the proposed manufacturer's system.

C. Material:

1. All material which is Contractor furnished shall be new, unused and free from defects.
2. Where more than one of any specified item of equipment or material is used, all such items shall be the same product from the same manufacturer.

1.4 REFERENCES

A. International Building Code

B. NFPA 70 - National Electrical Code.

C. The BOCA National Building Code

D. UL 294 - Standard for Access Control Systems.

E. UL 603 - Standard for Power Supplies for Use with Burglar Alarm Systems.

F. UL 609 - Standard for Local Burglar Alarm Units and Systems

G. UL 634 - Standard for Connectors and Switches for Use with Burglar Alarm Systems.

H. UL 827 - Standard for Central Station Alarm Services.

I. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems.

J. UL 1449 - Standard for Surge Protective Devices.

K. UL 1635 - Standard for Digital Alarm Communicator Systems.

L. UL 1638 - Standard for Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling.

M. UL 1778 - Uninterruptible Power Systems.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 28 05 00.

B. Product Data Submittal: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item.
2. All component options and accessories specific to this project.
3. Electrical power consumption rating and voltage including UPS sizing.
4. Heat generation for all power consuming devices.
5. Wiring requirements.
6. Server processor(s), workstation configurations, total and available disk space, and memory size.
7. All network bandwidth, latency and reliability requirements.

8. Backup/archive system size and configuration.
9. Submit two of each type of credential to be used (access card, key fob, etc.).

C. System Drawings: Project-specific system CAD drawings shall be provided as follows:

1. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical controllers), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where each controller will be located. This block diagram shall be provided in Adobe PDF.
2. Provide a schedule of all controllers and the doors/points each controller controls. This schedule shall be provided in Adobe PDF.
3. Provide schedules describing each system input location by an architecturally familiar reference, e.g., Door 312A. The architectural door schedule shall be used as the basis. These schedules shall be provided in Adobe PDF

D. Submit sample format of site specific programming guides to be used for system planning/programming conference with Government. These guides shall be provided in Adobe PDF.

E. So that required Government personnel are present at the planning/programming conference required in Part 3 of this section, submit meeting agenda for the conference a minimum of two weeks prior to the conference.

F. Submit detailed description of Government training to be conducted at project end, including specific training times. Refer to Part 3 of this section for details.

G. IP Addresses: Contractor shall provide to Government, in a documented transmittal and in Microsoft Excel format, the names and locations of devices which require an IP address. An authorized representative of the Government shall furnish the addresses for the associated devices in Microsoft Excel format in a documented transmittal. Should Government change the IP address structure after approval of the list, Government may be responsible for additional fees involved with reprogramming.

H. Quality Assurance:

1. Provide materials documenting experience requirements of the manufacturer and Installing Contractor. Provide documentation of the training and other applicable certifications of the Contractor.
2. Provide system checkout test procedure to be performed at acceptance. Test procedures shall include all external alarm events.

1.6 SYSTEM DESCRIPTION

A. This section describes the furnishing, installation, programming and commissioning of an existing Lenel/S2 complete, turnkey access control system. The terms "access control system" and "security management system", or SMS, may be used interchangeably herein.

B. The company, manufacturer, and product names used in this section are for identification purposes only. All trademarks and registered trademarks are the property of their respective owners.

C. Performance Statement: This section and the accompanying access control-specific design documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the vendor and the Contractor are solely responsible for determining all wiring, programming, and miscellaneous equipment required. The Contractor shall be responsible for determining quantities of materials required for a complete and operational system. Floor plan drawings and schedules have been developed to aid the Contractor in determining device quantities and installation locations, but, where discrepancies between floor plans and schedules arise, the greater number shall govern.

D. Basic System Description:

1. The access control system shall provide the following functionality:

a. Electronic control access to designated areas.
b. Validation of cardholder credentials by use of personnel database, card formats. The system shall compare the time, location, and unique credentials of an attempted entry with information stored in the database.
c. Access to designated areas will be validated only when a user's credential has a valid number for its facility and the number is valid for the current time and for the reader where it is used.
d. The system software shall access the hardware that validates the person and monitors the security of a building by use of intelligent system controllers, reader interfaces, locks, readers, inputs and outputs. When access has been validated, a signal to the portal locking device shall be activated to enable alarm free access at that location.
e. The system shall be configured by use of application software.
f. The system shall monitor activities using operator monitoring software which includes graphical maps which display alarms, status and activity.
g. The system shall differentiate and restrict administrative and operational access through use of password authentication.
h. The system shall report on various aspects of the system by use of reports, both default and customizable. Reports shall be able to be printed.
i. The system shall have the capability to report alarms both audibly and visually.
j. The system shall control hardware from the monitoring station by use of manual actions and events.
k. The system shall provide record and data management by use of journals. There shall be a full audit trail.
l. The system shall allow for data to be imported from other products by use of database migration tools. These products may include Human Resources databases for name and/or time and attendance information, information from previous access control systems consisting of badge numbers from credentials that will be re-used, Microsoft Excel spreadsheets, or other systems as defined herein.
m. The system shall allow access using a web interface or a mobile application for use on the iOS and Android operating systems.
n. The system shall utilize Open Supervised Device Protocol (OSDP) version 2.0 or later to all peripheral devices.

1.7 OWNER FURNISHED MATERIAL

A. Telephone service

B. Data circuit / internet service

C. Active telephone service equipment, such as key system, PBX or VOIP switch equipment

D. Active computer network equipment:

1. Routers
2. Switches
3. Hubs
4. Wireless access points
5. Uninterruptible power supplies for Government furnished products

E. Active computer equipment:

1. SMS server - refer to Part 2 for details
2. SMS workstation(s) - refer to Part 2 for details
3. SMS badging station(s) - refer to Part 2 for details
4. Uninterruptible power supplies for Government furnished products

F. Credentials:

1. Badges
2. Key fobs
3. Adhesive tags
4. Active transmitters

1.8 LICENSING REQUIREMENTS

A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include server and workstation software, network controllers, card readers, printers, badging stations, and any other licensing that is required by the manufacturer for operation of any system component.

1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, license blocks provided shall be no greater than what is required for the number of devices in this project. Contractor shall document the number of remaining licenses in the project record documents and Operations and Maintenance data.
2. The system described herein is an extension of an existing Lenel/S2system. All licensing shall be new for each installed device. The Contractor shall not use any of the Government's existing (spare) licenses for any new components.

3. All Contractor-furnished software shall contain a perpetual, permanent license in which no other fees beyond the single payment for the work of this section are required in order to use the proposed software indefinitely. Government understands that, after the initial warranty period has expired, maintenance and technical support fees may be required annually, quarterly, or monthly in order to receive software updates and technical support. However, it remains the option of Government to purchase or decline this service. If Government chooses to discontinue or never purchase this service, the software shall continue to be legally licensed for use. All software shall be the latest version released, and all Contractor-furnished servers and workstations shall be current on all patches and updates for all software on the machines at the time of acceptance of the associated systems.
4. The SMS shall require only a single license key present on the server for the SMS to operate. The key shall be a physical device or a software key. License keys shall not be required at the client workstations.

1.9 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 28 05 00.

B. Provide final system block diagram showing any deviations from shop drawing submittal.

C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.

D. Provide schedules documenting:

1. Controller installation locations including specific door numbers being controlled.
2. All terminal block wiring, including cable numbers.

E. Warranty: Submit written warranty and complete all Government registration forms.

F. Complete all operation and maintenance data manuals as described below.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit documents under the provisions of Section 28 05 00.

B. Manuals: Final copies of the manuals shall be delivered within 30days after completing the installation test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the contractor responsible for the installation and maintenance of the system, and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. Manuals shall be submitted in electronic format only, Adobe PDF. The manuals shall consist of the following:

1. Hardware Manual: The manual shall describe all equipment furnished including:

a. General description and specifications.
b. Installation and check out procedures.

c. System and equipment layout and electrical schematics to the control board and field device level. For multiple devices wired identically, only one wiring diagram is required per door configuration, to be labeled "TYPICAL".
d. Alignment and calibration procedures.
e. Manufacturers repair parts list indicating sources of supply.

2. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

a. Definition of terms and functions.
b. System use and application software.
c. Initializations, startup, and shutdown procedures.
d. Reports generation.
e. Details on forms customization and field parameters.

3. 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.
b. Log in/Log out procedures.
c. Use of system, command, and applications software.
d. Recovery and restart procedures.
e. Graphic alarm presentation.
f. Use of report generator and generation of reports.
g. Data entry.
h. Operator commands.
i. Alarm messages.
j. System permissions functions and requirements.

4. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, cleaning, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.11 WARRANTY

A. Unless otherwise noted, provide warranty for one (1) year after date of Substantial Completion for all materials and labor.

B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.

1. Inspections: The Contractor shall perform two minor inspections at six-month intervals (or more often if required by the manufacturer), and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
2. Minor Inspections: These inspections shall include:

a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.
b. Mechanical adjustments if required on any mechanical or electromechanical devices.

3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:

    a. Clean all equipment, including exterior surfaces and accessible and serviceable interior surfaces.
    b. Perform diagnostics on all equipment.
    c. Check, test, and calibrate (if required) all sensors.
    d. Run all system software diagnostics and correct all diagnosed problems.

C. Operation: Upon the completion of any scheduled adjustments or repairs, Contractor shall verify operation of the SMS.

D. Service: The Government will initiate service calls when the SMS is not functioning properly. If requested by the Government, the Contractor shall respond or remain at the site after normal business hours, and the Government shall reimburse the Contractor for the incremental cost difference between premium labor rates and standard labor rates. This reimbursement applies to premium labor rates that do not exceed time-and-one-half rates after normal business hours and double-time rates for Sundays and holidays. The Government shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Qualified service personnel shall be at the site within 24hours after receiving a request for service.

E. Records, Logs and Work Requests: Contractor shall keep records and logs of each task completed under and outside of warranty. These logs shall be maintained in Microsoft Word or Excel. The log shall include the model and 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, description of work performed, the amount and nature of the material used, and the time and date of commencement and completion of the work. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the SMS. The Contractor shall deliver a record of the work performed within three (3) business days after work is completed. Defective items that have been replaced shall be given to the Government. Should the replacement item be a temporary replacement until the removed item is repaired, Contractor shall retain possession of the defective item for repair and subsequent re-installation.

F. System Modifications: Modifications by the Contractor are allowed after system acceptance. Contractor shall make recommendations for system modification in writing to the Government. No system modifications shall be made without prior, written approval of the Government. Any modifications made to the system shall be incorporated into the Operations and Maintenance Manuals, and other documentation affected. The Government shall be provided with electronic restorable versions of all configurations prior to the modifications being made.

G. Software: At no charge, the Contractor shall provide to Government all updates released by the manufacturer during the period of the warranty and verify operation of the system upon installation. These updates include system software updates, patches, bug fixes and revisions, as well as firmware updates. These updates shall be accomplished in a timely manner, fully coordinated with SMS administrators and operators, shall include training for the new changes/features, and shall be incorporated into the Operations and Maintenance Manuals and software documentation.

H. Refer to the individual product sections for further warranty requirements of individual system components.

PART 2 - PRODUCTS

2.1 ELECTRONIC ACCESS CONTROL SYSTEM MANUFACTURERS

A. LenelS2 OnGuard

2.2 FIELD CONTROL HARDWARE

A. Interior Control Panels:

1. Control boards, power distribution and terminals shall be enclosed in a NEMA 1 rated enclosure that is key lockable. Contractor shall not furnish padlock. All enclosures that are part of this project shall be keyed alike. Contractor shall furnish and install a mechanically fastened tamper switch on the interior of the enclosure.
2. Control boards are allowed to be in an enclosure separate from the power supplies/power distribution. Should they be in separate enclosures, the interface wiring shall be in rigid metallic conduit, RMC, with Myers hubs at both ends of the conduit.
3. Intra-enclosure wiring shall be dressed using tie wraps and/or covered plastic wire way. Hook-up wires for identical purposes shall have the same color insulation. For example, if one input pair utilizes green and white insulated conductors, all similar inputs shall use green and white insulated conductors. The same color scheme shall be followed for all access control panels that are part of this project.
4. Cabling from field devices such as readers, door position switches, request-to-exit devices and locking devices shall not be directly terminated to the control boards and power supplies. The field devices shall be terminated to terminals located on the left side, right side or both sides of the enclosure back panel. Intra-enclosure wiring shall be routed from the terminals to the control boards and power distribution. Quantity and functional sequence of the terminals shall be identical portal to portal.
5. All devices inside the enclosure, less cabling and batteries, shall be mechanically fastened to a removable solid or perforated metal back panel with either:

    a. Metal or plastic standoffs
    b. DIN rail

6. Hook and loop fasteners, double sided tape or adhesives are not allowed to attach devices to the back panel. Mounting devices to the interior of the door shall only be allowed when the following two (2) conditions are met:

    a. The access control hardware manufacturer offers prefabricated enclosures with devices mounted to the interior of the door.
    b. Only the same devices that the access control manufacturer mounts to the interior of the door are allowed to be mounted in a different enclosure, and those devices shall be mounted in an identical manner.

7. 120V 20A input power shall be hard wired to a circuit breaker disconnect and to one duplex receptacle on the interior of the enclosure. Should devices in the enclosures require plug-in transformers/power supplies, the receptacle shall be utilized. One (1) power strip with integrated circuit breaker shall be located in the bottom of the enclosure as needed.

8. Power to the locking devices shall be provided by a power distribution board with no fewer than four (4) outputs. Each lock shall be individually protected. The power distribution board shall:

    a. Provide protection with fuses or positive temperature coefficient (PTC) devices.
    b. Provide control so that each output is individually selectable as latching or non-latching with fire alarm activation.
    c. Provide control so that each output shall have Fail Safe and Fail Secure terminals.
    d. Provide a fire alarm input with associated trigger LED.
    e. Provide an individual LED per output to indicate when an input has been triggered and the associated output has been activated.
    f. Accept a dry, closed contact input to activate the individual lock outputs.
    g. Provide a dry, Form C relay that energizes on activation of the fire alarm input. This output may then be used as a fire alarm input to other power distribution boards in the same or a different enclosure, or may provide input to another device such as a multi-pole relay.

9. A minimum of four () 12V 7 AH rechargeable, sealed, lead acid batteries shall be located in the bottom of the enclosure. Two of the batteries shall be connected in series for 24V devices, and two batteries shall be connected in parallel for 12V devices. Connections to the batteries shall be made with appropriate terminals crimped on the connecting conductors. Batteries shall be clearly labeled in a permanent manner with the date of installation.
10. Power to control boards, readers and auxiliary devices such as request-to-exit motion detectors shall be provided by a power distribution board with no fewer than four (4) outputs. All devices powered by the same voltage at an individual portal shall be protected by the same fuse or PTC unless current requirements dictate otherwise. Individual fuses or PTCs may protect more than one control board.
11. All access control panels, when populated with control boards and power supplies, shall have the following capacities:

    a. Control of a minimum of two (2) portals.
    b. Spare capacity of a minimum of one (1) access control portal, two (2) auxiliary inputs and two (2) auxiliary outputs greater than the requirements of the project at the time of system specification.
    c. Five (5) spare fuses of each type used, to be in their original packaging, to be located in each power supply enclosure.
    d. 50% spare current capacity on all power supplies located in unconditioned spaces and 40% spare capacity for those in conditioned spaces. Lower spare capacities are allowable based on prior approval of Contractor-provided power calculations.

12. Locations where enclosures may be mounted are shown on the plans. Final location, with approval of Government's representative, shall be selected by Contractor based on distribution of controlled portals and devices.
13. At time of Substantial Completion, Contractor shall furnish a schematic diagram of intra-enclosure wiring and a complete bill of materials for the enclosures and the devices located within. This documentation shall include a schedule of fuses and the device(s) that each fuse protects. This documentation shall be placed by Contractor in a Contractor-furnished print pocket located on the inside of the enclosure door.

B. Intelligent System Controllers (ISC):

1. The controller shall communicate with the host via an on board 10/100/1000 Base T Ethernet port.

2. The controllers shall be a distributed architecture with full peer-to-peer networking capability. Parent/Child controller configurations are not acceptable. All controllers in the system shall be capable of operating in a standalone mode if communication is lost with the server or main controller. In no case shall a controller depend on communication with an upstream controller for proper standalone operation.
3. The communications bus shall be supervised for wiring integrity. If a communication failure is detected, the system shall report the loss. All controllers unable to receive communication shall operate as standalone devices including grant/deny decisions, complete with event buffers. All events shall be uploaded to the server upon restoration of communications.
4. Controllers shall be AES 128-bit symmetrical block encryption devices conforming to FIPS-197.
5. Controllers shall support a minimum of SHA-2 authentication security.
6. The controllers shall utilize flash memory or similar technology, allowing program updates to be downloaded from the server. Program storage shall be in ROM.
7. The controllers shall have the capacity for 15,000 cardholders and 45,000 transactions. All access decisions involving these cardholders shall be made at the lowest controller level without communication to the server.
8. Handle all non-host related access control monitoring and decision making.
9. LED indicators for power, fault and communications.
10. Provide for local and global input/output linking:

    a. The SMS shall support a global linkage feature whereby any input/output/event shall be linked to any other input/output/event in the SMS. Input/output linkages shall be able to span across intelligent system controllers.
    b. System administrators shall be able to create global input/output function lists, each consisting of a sequence of actions to be performed, such as changing card reader modes, activating outputs, and opening or closing anti-pass back areas. Each function list may include up to six actions.

11. Reporting of transactions and status information to the server.
12. Interface with standard reader technologies without special interface hardware, additional logic panels or other integrators. Supported technologies shall include:

    a. 13.56 MHz Contactless Smart with or without biometrics or keypad
    b. 13.56 MHz Multi-technology Smart
    c. Proximity, with or without keypad
    d. Magnetic stripe, with or without keypad
    e. Wiegand
    f. QR Code/Bar code
    g. Keypad
    h. Biometric, with Wiegand output
    i. OSDP

C. Reader Interface Module (RIM):

1. Reader interface modules are not shown on the plans. Refer to the installation section of this specification for allowable equipment mounting locations. It is the responsibility of the Contractor to determine the number and configuration of reader interface modules required based on the inherent characteristics of each product line and the requirements and restrictions described in this document.
2. RIM shall interface with and accept data from TTL, OSDP, Wiegand and RS-485 type readers and door hardware.

3. RIM shall provide a minimum of three (3) inputs per portal for portal position, request to exit and auxiliary input.
4. RIM shall provide a minimum of two (2) outputs per portal for locking device and auxiliary output. Each output shall be Form C and shall be rated at 3A at 28VDC.
5. RIM shall communicate to controller by RS-485.

D. Input Control Module (ICM):

1. The input control module shall provide supervised and non-supervised alarm input zones and monitor/report line fault conditions, alarm conditions, power faults and tampers.
2. Input control modules are not shown on the plans. Refer to the installation section of this specification for allowable equipment mounting locations. It is the responsibility of the Contractor to determine the number and configuration of input control modules required, based on the inherent characteristics of each product line and the requirements and restrictions described in this document.
3. UL 294 and 1076 listed.
4. Each input configurable for normally open or normally closed.
5. Each input configurable for timing.
6. Each input configurable for end of line resistance.
7. Status LEDs for communication to the host, heartbeat and input status.
8. Communications line supervision.
9. AES 128 bit encryption.
10. 2-wire RS485 communications.
11. No fewer than eight (8) inputs per board/control module.
12. Alarm Masking: The ability to mask the alarm input on a time zone basis.
13. Activate Output: The ability for any input to activate any output.
14. Configuration of Debounce Time: The ability to control the amount of time that an input state change must remain consistent in order for it to be considered a real change of state.
15. Elevator control support for number of floors shown on the drawings.
16. Global Linkage: The ability to link outputs with inputs that are attached to any ICM/output control module (OCM).
17. Checkpoint: The ability to configure an input as a designated stop on one or more guard tours.
18. Entry/Exit Delay: The ability to set up entry/exit delays for inputs that are attached to any ICM. This shall include:

    a. Non-Latched Entry: When an input activates, the alarm will not be reported until the entry delay expires. If the input is still active when the entry delay expires, the alarm will be reported. If the input is not active when the entry delay expires, then the alarm will not report.
    b. Latched Entry: When an input activates, the alarm will not be reported until the entry delay expires. If the input is still active when the entry delay expires and the alarm has not been masked, the alarm will be reported. If the input has been masked when the entry delay expires, then the alarm will not report.
    c. Exit Delay: When an input activates, the alarm will not be reported (operates as if masked) until the exit delay expires. If the input is still active when the exit delay expires, the alarm will be reported. If the input is not active when the exit delay expires, the alarm will not be reported.

2.3 PORTAL DEVICES

A. Credential Readers:

1. Manufacturers:

   a. HID Signo Series
   b. Refer to drawings for approved manufacturers.

2. Multi-Technology:

   a. Compatible with 125 kHz proximity, 13.56 MHz Contactless Smart card, MIFARE, DESFire EV1.
   b. Backwards compatibility with legacy 13.56 MHz Contactless Smart cards and 125 kHz proximity access control formats, including 26, 32, 35, 37 bit as well as HID Corporate 1000 format.

3. Card readers manufactured specifically for non-access control applications shall not be acceptable.
4. FIPS 201 compliant.
5. Provide compatibility with most access control systems by providing card data outputs in Wiegand.
6. Compatible with OSDP access control systems.
7. Allow the firmware to be updated in the field without the need to remove the reader from the wall.
8. Secure mounting methods using tamper resistant screws.
9. An audio beeper that provides various tones to signify access granted, access denied, power up and diagnostics.
10. Tri-color LED or three (3) LEDs for visual notification of various conditions.
11. ISO1443A, 1443B and 15693 compliant.
12. The ability to transmit an alarm from an integrated tamper switch.
13. Support dual authentication of identity through the combined use of access badge and personal identification number (PIN) on an integrated 12 key keypad.
14. PBT polymer or UL94 polycarbonate.
15. Read Range:

    a. Using 125 kHz cards or 13.56 MHz Contactless Smart cards, minimum operational read range shall not be less than one (1) inch after the readers have been installed in their permanent locations.

16. Operational voltage of 5-16 VDC, with operating temperature range of -31° F to 150° F, and rated for outdoor use with a minimum rating of IP55.
17. Readers and credentials shall be compatible with each other and shall be from the same manufacturer.
18. Available in sizes to be mounted to a standard single gang box or to a mullion. Maximum sizes:

    a. Single gang box mount, with or without keypad: 5.1" x 3.1" x 1.1"
    b. Mullion mount: 6.0" x 1.9" x 0.9"

19. Lifetime warranty against defects in material and workmanship.

B. Door Position Switch:

1. Manufacturers:

a. GE
b. GRI
c. Honeywell
d. Pre-approved equal

2. Interior or Perimeter Door:

a. One (1) inch or 0.75 (3/4) inch diameter, recessed
b. DPDT contacts
c. 0.75" to 1.25" (3/4" to 1-1/4") gap for wood door
d. Maximum 0.375" to 0.625" (3/8" to 5/8") gap for steel door
e. Basis of Design: UTC/GE/Sentrol 1076D

C. Cable:

1. Composite cable is allowed, although sufficient conductors may not be available in composite cables for all portal configurations. Contractor shall be responsible for additional required cables beyond one composite cable to each portal to meet functional requirements of the system.

a. Weigand Reader: 18 AWG, 3 pair, stranded, overall shield. Shield shall be grounded at control panel end only.
b. Door Position Switch: 22 AWG, 2 conductor, stranded.
c. Lock: Minimum 18 AWG, 4 conductor, stranded.

1) Lock may require heavier gauge cable depending on door hardware solution power requirements. Contractor shall coordinate with door hardware provider for higher current devices and shall adjust the gauge of the lock cable accordingly.

d. Auxiliary Devices: Refer to plans for requirements.

D. Locks and Door Hardware:

1. Electric/electronic locks shall be furnished and installed by the door hardware provider.
2. Access Control Contractor shall interface with and terminate cables to locks.
3. Access Control Contractor shall coordinate with door hardware provider for specified sequences of operation at the various portals.
4. Magnetic locks shall have a magnetic bond sensor.
5. Refer to architectural specifications and/or the architectural door schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Provide all system wiring between all components as shown on the project drawings or as directed by the manufacturer, whichever is the more stringent requirement.

C. Network controllers shall be installed centralized in the nearest telecommunications room(s). Mount controllers to the structural walls in a location coordinated with other utilities. Coordinate exact location with Government prior to installation. Provide dedicated +120 VAC emergency power circuit to the controllers using #12 AWG wiring from the nearest emergency electrical power distribution panel board.

D. Provide wiring and connection to all electrified locking hardware devices. Complete programming and testing of all electrified locking hardware devices.

E. Install all credential readers in accordance with manufacturer's instructions where shown on floor plans, in accordance with the Americans with Disabilities Act (ADA) requirements. Provide wiring and connection to all credential readers. Complete programming, adjustment, and testing of all credential readers.

F. OSDP Configuration: All OSDP devices shall be configured to use secure channel encryption and secure channel requirements when available and installation mode is to be turned off after installation. Follow SIA recommendations for configuring secure OSDP devices.

G. Install all door alarm contacts in accordance with manufacturer's instructions either recessed in the door header or surface mounted as required. Provide wiring and connection to door alarm contact devices. Complete programming, adjustment and testing of all door alarm contacts.

H. Contractor shall provide all cabling, wiring, terminations, components, devices, accessories, hardware, software and other material and accessories necessary to complete all specified interfaces and integrations and make them fully operational.

I. All low voltage access control cabling shall be routed and supported completely separate from any and all other telecommunications or other low voltage system cabling.

J. Electronic access control system cabling shall not be spliced.

K. Flexible conduit is not allowed except with prior approval. Refer to Section 26 05 33 for conduit requirements. Refer to Section 27 05 28 for cable hanger and support requirements.

L. Each cable shall be appropriately identified, as defined on the record documents, at each end's termination point using pressure sensitive label strips.

M. The conductor color code used in terminating system cabling at system devices shall remain consistent from device to device for each unique device type throughout the project.

N. Install and tighten all connectors in accordance with manufacturer's instructions using the appropriately designed tools recommended by the manufacturer for that purpose. Do not strip or damage connectors, terminals, or equipment by over tightening termination fasteners.

O. Grounding and Bonding Requirements:

1. Provide a minimum of 6AWG bonding conductor from each electronic access control system control panel, power supply and surge suppression device to the nearest telecommunications grounding busbar. Actual bonding conductor size is determined by its length; refer to Section 27 05 26 for grounding and bonding conductor sizing criteria.

2. Cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground the shield only at the control panel end.

P. Coordinate installation of all devices with other trades and utilities in the vicinity.

Q. Cabling shall be plenum rated when installed outside conduit in plenum ceilings.

3.2 FIELD QUALITY CONTROL

A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications as supplied and warranted by the system manufacturer. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system manufacturer.

B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL) as suitable for purpose specified and indicated.

3.3 MANUFACTURER AND INTEGRATOR COMBINED FIELD SERVICES

A. Installation shall be performed by a factory-trained and certified Contractor.

B. The Contractor shall provide a comprehensive, site-specific customer planning guide for the system. The Contractor shall conduct conference(s) with the Government prior to any installation to discuss the programming and configuration options of the system and the planning guide.

C. The Contractor shall include labor for all planning and all programming activities required to implement the Government's access policies for each system point and each operator and administrator. Any software programmable access policy, within the bounds of the hardware specified, shall be included.

D. It shall be the responsibility of the Contractor to provide a complete, functional system as described by the design documents. These responsibilities include:

1. Complete hardware setup, installation, wiring and software configuration of the system server, all workstations and all peripheral hardware.
2. Complete programming of all operator software in accordance with the Government's access policies determined by the planning guide conference(s).
3. Complete system diagnostic verification.

E. The SMS Installation Contractor shall be present at meetings to coordinate all door hardware requirements with the door hardware vendor.

3.4 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided for the system. The documentation shall describe:

1. All operational parameters of the system
2. Complete documentation of programming and access policies
3. Complete operating instructions for all hardware and software

B. The following sections shall be provided in the system documentation:

1. System Administrator Manual: Provides an overview and a step-by-step guide and instructions detailing all system administrator responsibilities and functions.
2. User Manual: A step-by-step guide and instructions detailing all system user functions.
3. Alarm Monitoring Manual: A step-by-step guide and instructions detailing all alarm monitoring system functions and responsibilities.
4. Technical Maintenance Manual: A comprehensive document providing all maintenance actions, system testing schedules, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.
5. Refer to Part 1 for details.

3.5 SYSTEM TRAINING

A. All labor and materials required for on-site system training by a certified representative of the system manufacturer shall be provided. Training shall be conducted at the project site using the project equipment.

B. Coordinate training days and times with Government.

C. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

D. At a minimum, the following training shall be conducted:

1. System Administrators: A course detailing the system functions, configurations and operations. Provide training on all aspects of the system including data import/export, report, cardholder management, system workstation and server configuration and maintenance, software and hardware configuration and peripheral hardware operation.
2. Operators: A course detailing the operational features of all aspects of the user interface. Topics shall include alarm monitoring functions, reports, error handling, alarm handling, output relay control, operation of integrated systems interface, and general overview of the report hardware.
3. GUI Editing: Conduct detailed training on using the GUI editing software. Topics shall include the editing of existing graphical maps and the creation of new graphical maps.

3.6 SYSTEM ACCEPTANCE

A. The SMS vendor shall submit for review a formal acceptance and system checkout program. The system checkout procedures shall include all system components, software and functionality. The Contractor shall perform the tests and document all results under the supervision of the manufacturer's systems engineer.

B. All operational scenarios, as defined by the customer planning guide, shall be tested to simulate the actual use of the system in the normal operating environment. The successful completion of these operational scenarios shall be documented.

C. The system shall not be accepted until all requirements of system documentation and training have been completed.

END OF SECTION 28 13 00

SECTION 28 31 00 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire alarm and detection systems.

1.2 RELATED WORK

A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 QUALITY ASSURANCE

A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.

B. Installer: A factory-authorized Electrical or Security Contractor licensed with the State and local jurisdiction with five years' experience in the design, installation, and maintenance of fire alarm systems by that manufacturer.

C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the start-up and testing reports.

1.4 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

B. NFPA 72 - National Fire Alarm and Signaling Code

C. NFPA 101 - Life Safety Code

D. UL 2017 - General Purpose Signaling Devices and Systems

E. UL 217 / 268 - Standard for Smoke Alarms / Smoke Detectors for Fire Alarm Systems

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00 and as noted below.

1. Failure to comply with all the following and all the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.

2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.

B. Provide product catalog data sheets as shop drawings.

1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings, but required for the operation of the system.
2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.
3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.

C. Submit CAD Floor Plans as Shop Drawings:

1. The complete layout of the entire system, device addresses, auxiliary equipment, and manufacturer's wiring requirements shall be shown.
2. A legend or key shall be provided to show which symbols shown on the submittal floor plans correspond with symbols shown on the Contract Documents.

D. About all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.

E. Provide installation and maintenance manuals under provisions of Section 26 05 00.

F. Submit manufacturer's certificate that system meets or exceeds specified requirements.

G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.

H. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Store and protect products under provisions of Section 26 05 00.

1.7 REGULATORY REQUIREMENTS

A. System: UL or FM Global listed.

B. Conform to requirements of NFPA 101.

C. Conform to requirements of Americans with Disabilities Act (ADA).

D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling.

1.8 SYSTEM DESCRIPTION

A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.

C. Extending the Existing Fire Alarm System: Provide all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to extend the existing fire alarm system. This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, auxiliary control and related devices such as, door holders and their control, smoke damper control, fan shutdown, etc. The existing fire alarm system shall be extended such that the existing fire alarm system's functionality, integrity and annunciation shall be equivalent to pre-construction conditions, unless noted otherwise. The functionality and integrity shall be maintained during construction. The entire system shall be able to be completely reset from any single reset location point. The entire system shall be annunciated at any annunciation location.

D. Extending the Existing SIMPLEX 4120 Fire Alarm System: The existing control panel shall remain and shall be operational throughout construction. The system shall only be disabled to make new connections and to modify the programming. A fire watch shall be provided for all areas affected during outages. All system outages must be scheduled with the Government at least one week prior. Individual devices may be disabled as needed based on construction activities to reduce the potential for false alarms, but all devices must be operational when the Contractor is not physically on site. New initiating devices may be connected to the existing signaling line circuits where capacity is available. Provide additional signaling line circuits as needed based on existing and new device quantity, including replacement of existing panel components. Provide new notification circuits to serve the new devices, including all necessary power supplies, amplifiers, batteries, and 120-volt input circuits. All new devices shall be programmed to provide the same sequence of operation as the existing devices of the same type, unless noted otherwise.

E. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.

F. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

G. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.

H. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.

I. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.9 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 26 05 00.

B. Include location of end-of-line devices.

C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.

D. Submit test results of sound pressure level (dBA) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit data under provisions of Section 26 05 00.

B. Include operating instructions, and maintenance and repair procedures.

C. Include results of testing of all devices and functions.

D. Include manufacturer's representative's letter stating that system is operational.

E. Include the CAD floor plan drawings.

F. Include shop drawings as reviewed by the COR and the local Authority Having Jurisdiction.

1.11 WARRANTY

A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.

B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Johnson Controls - Simplex

2.2 FIRE ALARM PATHWAY CLASS AND SURVIVABILITY LEVEL

A. Pathway Class:

1. Pathway Class B: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.

B. Pathway Survivability Level:

1. Pathway Survivability Level 0: Circuits have no requirements for pathway survivability beyond the requirements of the code.
2. Shared Pathway Designation Level 1: Physical segregation of life safety and non-life safety data is not required. Life safety data shall be the priority.

2.3 SIGNALING LINE CIRCUIT DEVICES

A. Combination Devices: Subscripts identify combination type devices when applicable. Contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device.

B. Signal Line Device(s):

1. Subscripts: Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

a. Device type as follows:

1) W = Weather Proof
2) Candela Ratings:

a) ## = 15 Candela, 30 Candela; 75 Candela; 110 Candela; 177 Candela

C. FA-120; Smoke Detectors:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

a. Device types as follows:

1) Blank = Photoelectric

2. (BLANK) Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
3. Each smoke detector shall connect directly to an SLC loop, unless listed as stand alone.
4. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.
5. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

6. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.
7. A test means shall be provided to simulate an alarm condition.
8. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.

D. FA-122; Duct Smoke Detectors, Sampling Tube Type:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

   a. Device types as follows:

      1) # = Equipment or system

   b. Duct-type smoke detectors shall use the same analog photoelectric sensor technology, with the same features specified for standard smoke detectors, except with additional features as specified below.
   c. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where the detector housing is larger than the duct height, Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer's recommendations.
   d. Provide a remote alarm LED indicator device (FA-241) or (FA-242) if detector is not visible from a floor-standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.

E. FA-130; Manual Pull Stations:

1. Manual pull station, addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provided with all necessary mounting hardware. Use surface mount only on precast concrete or structure.
2. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.
3. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32°F and 120°F.

F. FA-161; Addressable Control Module:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

   a. Device types as follows:

      1) Blank = Refer to Plans

2. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional child relay(s), as required, rated for the electrical load being controlled (Contractor to match voltage, amps, etc.).
3. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.
4. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.
5. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2.4 NOTIFICATION APPLIANCE DEVICES

A. Combination Devices: Subscripts identify combination type devices when applicable. Contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device.

B. Notification Appliance Device(s):

1. Subscripts: Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

a. Device types as follows:

1) W = Weather Proof
2) Candela Ratings:

a) ## = 15 Candela; 30 Candela; 75 Candela; 110 Candela; 177 Candela

C. Notification Device(s):

1. Wall Mounted: White housing with red lettering or pictogram.
2. Ceiling Mounted: White housing with red lettering or pictogram.

D. FA-200; Visual Alarm Devices:

1. Wall or ceiling mounted, refer to plans.
2. High intensity (Candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.
3. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.
4. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
5. (W) Weatherproof Visual Notification Device: High intensity strobe, square housing, 75 Candela rating, suitable for wet locations. Provide with weatherproof back box.

a. Mounting: Semi-flush wall.
b. Conduit shall not be exposed.

E. FA-210; Audio Horn Alarm Devices:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
2. Wall or ceiling mounted, refer to plans.
3. Sound Rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the occupied area.
4. Device shall be capable of a high and low dB level setting. Unless noted otherwise, the device shall be set to the high setting at building completion.
5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

F. FA-211; Combination Audio Horn and Visual Alarm Device:

1. Wall or ceiling mounted, refer to plans.
2. Combine audio and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.
3. (W) Weatherproof Audio/Visual Notification Device: Electronic horn with high intensity strobe, square housing, 75 Candela, suitable for wet locations. Provide with weatherproof back box.

   a. Mounting: Semi-flush wall.
   b. Conduit shall not be exposed.

2.5 NOTIFICATION APPLIANCE CIRCUIT PANEL (NAC)

A. As shown on the plans or as a Contractor's option if not shown, furnish and install NAC extender panels as necessary to provide remote power supply for notification appliance circuits (NAC). Contractor shall indicate quantity and locations of each NAC on the shop drawing submittals.

B. Each NAC shall be self-contained remote power supply with batteries, and battery charger mounted in a surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NAC provides a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.

C. Power for each NAC shall be from a local 120 VAC emergency circuit. Provide two #12 conductors and one #12 ground in 1/2" conduit to each NAC from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Coordinate panel and circuit number with the COR prior to installation.

D. NAC extender panels may be installed only in locations coordinated with the COR.

E. Mounting: Surface.

2.6 WIRING

A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with the Electrical Code for power-limited fire alarm signal service.

B. Fire Alarm Cable:

1. Manufacturers:

a. Comtran Corp.
b. Helix/HiTemp Cables, Inc.
c. Rockbestos-Suprenant Cable Corp.
d. West Penn Wire/CDT.
e. Radix.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

A. General:

1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
2. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:

1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder, and annunciator locations.
2. A local signal in the control panel shall sound.
3. The LCD display shall indicate all information associated with the condition, including the name of the item, type of device and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated with the fire alarm control panel (FAP) condition, along with the time and date.
5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital communicator.

C. Audible Alarms Sequence:

1. Audible alarms throughout the building shall sound.

D. Visual Alarms Sequence:

1. Visual alarms throughout the building shall flash.

E. AHU and Mechanical Fan Shutdown Sequence:

1. The fire alarm system shall utilize addressable relays to de-energize all AHU motor controllers and mechanical fans. Coordinate other requirements with HVAC installer.
2. The fire alarm system shall directly shut down the AHU or mechanical fan through the local HVAC control device (i.e., variable frequency drive or motor starter).

3. Where a facility has more than one AHU or mechanical fan, each shall be shutdown individually based on input from initiation devices in the area served by the unit or designated for each air distribution system.

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Devices:

1. General:

a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall adjust location of device so that new location meets all requirements in NFPA 72 and all applicable building codes.

2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.
3. Protection of Fire Alarm System:

a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.

4. Duct-type Analog Smoke Detectors:

a. Duct-type analog smoke detectors shall be installed on the duct where shown on the drawings and details. The sampling tubes shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
b. All detectors shall be accessible.
c. Duct-type detectors shall be installed according to the manufacturer's instructions.

5. Manual Pull Stations:

a. Stations shall be located where shown and at the height noted on the drawings.

6. Addressable Relays and Monitor Modules:

    a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
    b. All modules shall be mounted in or on a junction box in an accessible location.
    c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.

7. Notification Appliance Devices:

    a. Devices shall be located where shown on the drawings.
    b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.

C. Wiring:

1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
2. Wiring shall be installed in conduit.
3. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 26 05 13 for color and identification requirements.
4. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
5. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.

    a. Fire alarm temporal audible notification for all audio appliances.
    b. Synchronization of all visual devices where two or more devices are visible from the same location.
    c. Ability to silence audible alarm while maintaining visual device operation.

6. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.

D. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.

1. Power Branch Circuit Conductors: In accordance with Section 26 05 53.
2. Signaling Line Circuit: Overall red jacket with black and red conductors.
3. DC Power Supply Circuit: Overall red jacket with violet and brown conductors.
4. Notification Appliance Circuit: Overall red jacket with blue and white conductors.
5. Central Station Trip Circuit: Orange conductors.
6. Central Station Fire Alarm Loop: Black and white conductors.

E. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.

F. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 00.

B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.

C. Contractor shall test and adjust the fire alarm system as follows:

1. Speaker taps shall be adjusted to the lowest tap setting which achieves a sound level higher than or equal to the greatest of the following:

    a. 70dBA.
    b. 15 dBA above ambient levels as indicated in NFPA 72 Table A.18.4.3.
    c. 15 dBA above measured ambient. 5 dBA above the maximum measured sound level with duration of more than 60 seconds.
    d. As specified on the drawings.

2. Sound level measurement procedure shall meet the following requirements:

    a. All measurements shall use the 'A' weighted, dBA, sound measurement scale.
    b. All measurements shall be taken after furnishings, wall coverings and floor coverings are in place.
    c. All measurements shall be taken after fixed equipment (HVAC units, etc.) producing ambient noise is installed and is in operation.
    d. All sound level measurements shall be taken at a height of 5' above the finished floor level.
    e. Measurements shall be taken in every unique room. If there are multiple rooms, which have the identical dimensions and function, 10%, or a minimum of two (2) rooms shall be tested. The results from the rooms tested shall be averaged and the remaining rooms may be adjusted per the average.
    f. Measurements shall be taken on a 20' x 20' grid and the results for all points taken shall be averaged. If the room is smaller than 20' x 20' a minimum of two measurements are required.
    g. Measurements shall be taken halfway between speakers or halfway between a speaker and the wall. No measurements shall be taken at the extreme edges of the room, nor directly under speakers.

3.4 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services under provisions of Section 26 05 00.

B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

C. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the actual room (signage) numbers that the Government selects. Contractor and fire alarm manufacturer shall coordinate the actual room numbers as the Government directs to identify each device. This list shall be a part of the floor plan record drawing to be turned in at the project closeout.

D. System Occupancy Adjustments: When requested by Government within 12 months of date of Substantial Completion, provide on-site system adjustments to suit actual occupied conditions. For this purpose, provide up to two (2) site visits, four (4) hours each visit, outside normal occupancy hours.

3.5 SYSTEM TRAINING

A. System training shall be performed under provisions of Section 26 05 00.

B. Minimum on-site training times shall be:

1. System Operators: One (1) day.

END OF SECTION 28 31 00

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

c. Material character is indicated by the boring logs.

1.2 REFERENCES

The publications 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2015) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D698	(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3786/D3786M	(2018) Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles

ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4718/D4718M	(2015) Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011; R 2018) Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833/D4833M	(2007; R 2020) Standard Test Method forIndex Puncture Resistance of Geomembranes and Related Products
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, [SM,] [SW-SM,] [SC,] [SW-SC,] [SP-SM,] [SP-SC,] [CL,] [ML,] [CL-ML,] [CH,] [MH]. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements which comprise stones less than 3 inches in any dimension.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.3.3 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is 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 a slab.

1.3.4 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136/C136M and ASTM D1140.

1.3.5 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 or ASTM D698 as applicable abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with ASTM D4718/D4718M. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.3.6 Topsoil

Material suitable for topsoils obtained from excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.3.7 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling that is performed merely to increase production.

1.3.9 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3.10 Select Granular Material

1.3.10.1 General Requirements

Select granular material consist of materials classified as [GW,] [GP,]

[SW,] or [SP,] by ASTM D2487 where indicated. [The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D1140. Provide a minimum coefficient of permeability of 0.002 feet per minute when tested in accordance with ASTM D2434.

1.3.10.2 California Bearing Ratio Values

Conform the combined material to the following sieve analysis:

Sieve Size	Percent Passing by Weight
2-1/2 inches	100
No. 4	40 - 85
No. 10	20 - 80
No. 40	10 - 60
No. 200	5 - 25

1.3.11 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 1-1/2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 1-1/2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.3.12 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 15 when tested in accordance with ASTM D4318.

1.3.13 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.3.14 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.4 SYSTEM DESCRIPTION

Subsurface soil boring logs and the subsoil investigation report are appended to the Specifications. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4.2 Blasting

Blasting will not be permitted.

1.4.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G[, [_____]]

SD-03 Product Data Utilization of Excavated Materials; G[, [_____]]

Rock Excavation

Shoulder Construction

SD-06 Test Reports

Testing

Fill and Backfill Test

Select Material Testing Porous Fill Testing for Capillary Water Barrier

Density Tests

Moisture Content Tests

Borrow Site Testing

Within 24 hours of conclusion of physical tests, submit 2 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Provide backfill containing a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and passing the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide 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 inches minimum width, color coded as specified 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. Provide permanent color and printing, 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
Purple	Irrigation Badger Well 5, Reclaimed Water, and Slurry Lines

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide Bedding material and rock conforming to IDOT State Standard Article 1005.01 Stone and Broken Concrete, Gradation RR1 for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 1-1/2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.4.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

2.5 CAPILLARY WATER BARRIER

Provide capillary water barrier 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. Conform to ASTM C33/C33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, or 1-1/2 inch and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77.

2.6 PIPE CASING

2.6.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated on drawings. Protective coating is not required on casing pipe.

2.6.2 Wood Supports

Treated Yellow Pine or Douglas Fir, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots

and roots over 2 inches in diameter to at least 18 inches below existing surface. See Section 31 11 00 Clearing and Grubbing. 3.2 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transport and deposit in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Spread any remaining topsoil with the completion of excavation and grading.

3.3 UNSUITABLE MATERIAL

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas, foundations, and concrete slabs and properly dispose of.

3.4 GENERAL EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 95 percent of ASTM D698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material or satisfactory material as applicable and compact to 95 percent of ASTM D698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case

allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.4.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be

used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.4.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.4.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 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. Take control measures 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, maintain the water level continuously, at least 3 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

3.4.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in, as determined by the Contractor’s Safety Engineer or other competent person. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.4.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.4.5.2 Removal of Unyielding Material

Where [overdepth is not indicated and] unyielding material is encountered in the bottom of the trench, remove such material 6 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.4.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.4.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members and of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.4.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.4.6 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact J.U.L.I.E at 811 or (800) 892-0123 and the affected utility for assistance in locating existing utilities. The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within 2 feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by

the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.4.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

3.5 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas shown on Drawing Sheets within the limits of the project site. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.6 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Strip top 4 inches of soil material from borrow area and stockpile. After removal of borrow material, regrade borrow pit using stockpiled soil material to contours which will blend in with adjacent topography. Maximum side slopes shall be three horizontal to one vertical. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.7 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.8 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. [For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.] Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.9 GROUND SURFACE PREPARATION

3.9.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.9.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary [to plus or minus 2 percent of optimum moisture. Minimum subgrade density shall be as specified herein.

3.10 UTILIZATION OF EXCAVATED MATERIALS

Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, as backfill, and for similar purposes. Dispose surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph DISPOSITION OF SURPLUS MATERIAL. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.11 BURIED TAPE AND DETECTION WIRE

3.11.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.11.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at 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, terminate the wire in the valve pit at the pump station end of the pipe.

3.12 FILLING, BACKFILLING AND COMPACTION

Place fill and backfill beneath and adjacent to any and all type of structures, as the structural elements are completed and
accepted/approved; and under pavements in successive horizontal layers of loose material not more than 6 inches in depth, or in loose layers not more than 5 inches in depth when using hand-operated compaction equipment. Compact to at least 90 percent of laboratory maximum density for cohesive materials or 95 percent of laboratory maximum density for cohesionless materials, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or against the structure. Moisture condition fill and backfill material to within range of +2 or -2 percent of optimum moisture content at the time of compaction. Aerate material excessively moistened by rain to a satisfactory moisture content.

Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish general compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish under pavements to a smooth surface by blading, rolling with a smooth roller, or both.

3.12.1 Trench Backfill

Backfill trenches to the grade shown. Backfill the trench to 4 feet above the top of pipe prior to performing the required pressure tests.

3.12.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.12.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.12.1.3 Bedding and Initial Backfill

Provide bedding of the type and 4 inch minimum thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Provide bedding for buried piping in accordance with Standard Specifications for Sewer & Water Construction in Illinois, current edition, Crushed Stone Chips, Crushed Stone Screenings, or Bedding Sand. Provide trench backfill of Granular Backfill under buildings and within 2' horizontally of impermeable surfaces. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe.

3.12.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, with satisfactory material. Place backfill material and compact as follows:

3.12.1.4.1 Roadways, Sidewalks, and Buildings

Place backfill up to the required elevation as specified. Provide trench backfill for buried piping in accordance with Standard Specifications for Sewer & Water Construction in Illinois current edition, of Granular Backfill under buildings and within 2 foot horizontally of impermeable surfaces. Place and compact backfill under structures and paved areas in 6 inch lifts to base of structure. Do not permit water flooding or jetting methods of compaction.

3.12.1.4.2 Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.12.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for 7 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12.3 Backfill and Fill Material Placement Over Pipes at Buildings and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.12.4 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation conforming to the requirements of gradation No. 4 for coarse aggregate in ASTM C33/C33M.

3.12.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.13 BACKFILL FOR UNDERDRAINAGE SYSTEMS

Clean sand, crushed rock, or gravel meeting the following requirements:

a. Perforated or Slotted-Wall Pipe: Backfill meeting requirements of

Type I material as specified in Table 1.

b. Open Joint Pipe: Type III backfill consisting of both Type I and Type II materials as specified in Table 1.

c. Blind or French Drains: Backfill consisting of Type I material as specified in Table 1.

d. Any Type Drain Used With Filter Fabric: Clean gravel or crushed stone or gravel conforming to ASTM C33/C33M coarse aggregate grading size 57, 67, or 7, or fill consisting of Type I material as specified in Table 1.

TABLE 1	
	Type I, Gradation E 11 ASTM C33/C33M
ASTM D422 Sieve Size	Percent ~~Passing~~
1.5 inches	--
1 inch	--
3/8 inch	100
No. 4	95 - 100
No. 8	--
No. 16	45 - 80
No. 50	10 - 30
No. 100	0 - 10

3.14 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene, ultraviolet resistant filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have the following manufacturer certified minimum average roll properties as determined by ASTM D4759:

	Class A _____	Class B _____
a. Grab tensile strength (ASTM D4632/D4632M) machine and transversed direction	min. [180]	[80] lbs.
b. Grab elongation (ASTM D4632/D4632M) machine and transverse direction	min. [15]	[15] percent
	Class A _____	Class B _____
c. Puncture resistance (ASTM D4833/D4833M)	min. [80]	[25] lbs.
d. Mullen burst strength (ASTM D3786/D3786M)	min. [290]	[130] psi
e. Trapezoidal Tear (ASTM D4533/D4533M)	min. [50]	[25] lbs.
[f. Apparent Opening Size (ASTM D4751)]	[[_____]]	[[_____]]
[f. Apparent Opening Size (ASTM D4751)]	[See Criteria Below]	
[(1) Soil with 50 percent or less particles by weight passing US No. 200 Sieve, AOS less than 0.6 mm (greater than #30 US Std. Sieve)]		
[(2) Soil with more than 50 percent particles by weight passing US No. 200 Sieve, AOS less than 0.297 mm (greater than #50 US Std. Sieve)]		
g. Permeability (ASTM D4491/D4491M)	[k fabric greater than k Soil]	
[h. Ultraviolet Degradation (ASTM D4355/D4355M)]	[70 percent Strength retained at 150 hours]	

3.15 SPECIAL EARTHWORK REQUIREMENTS FOR SUBSURFACE DRAINS

Excavate to dimensions indicated. Provide a bedding surface of no more than one inch of Type I subdrain backfill material and place on compacted native soil as indicated. Backfill around and over the pipes after pipe installation has been approved. Place special granular filter material in 6 inch lifts and compact with mechanical, vibrating plate tampers or rammers until no further consolidation can be achieved. Compact backfill overlying the special granular filter material as specified for adjacent or overlying work.

3.15.1 Granular Backfill Without Filter Fabric

3.15.1.1 Perforated or Slotted Wall Pipe

Place granular material as pipe is laid and extend fit for a minimum of [one] pipe diameter on each side of and 18 inches above the top of the pipe. Place a layer of kraft paper on top of granular filter before continuing with the backfill.

3.15.1.2 Open-Joint Pipe

Place both types of granular material specified as pipe is laid forming an aggregate filter around the pipe. Provide [Type II] material to envelope the pipe a minimum of one-half the pipe diameter or twice the maximum aggregate size, whichever is larger, on each side and on top of the pipe.

Place [Type I] material next to and on top of the [Type II] material to provide a total fill extending at least [one] pipe diameter on each side of and 18 inches above the top of the pipe. Place a layer of kraft paper on top of the granular filter before continuing with the backfill.

3.15.2 Granular Backfill Using Filter Fabric

3.15.2.1 Perforated or Slotted Wall Pipes

Wrap one layer of filter fabric around pipe in such a manner that longitudinal overlaps are in unperforated or unslotted quadrants of the pipe. Overlap fabric a minimum of 2 inches. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material and extend it for [one] pipe diameter, minimum of 6 inches on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.15.2.2 Open-Joint Pipe

Wrap one layer of filter fabric around pipe joints overlapping a minimum of 2 inches in the longitudinal direction and extending at least 6 inches on both sides of the joint. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material specified and extend it for a minimum of [one] pipe diameter on each side of and 18

inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.15.2.3 Blind or French Drains

Install filter cloth in trenches with smoothly graded sides and bottom, free of cavities or projecting rocks. Lay the cloth flat but not stretched [and secure with anchor pins]. Place filter cloth so that drain water must pass through the cloth into the specified granular filter material. Overlap ends at least of 12 inches. Place backfill on filter cloth in the direction of overlaps. Where fabric is damaged, place a new piece of filter cloth over damaged area and overlap at least of 12 inches in every direction.

3.16 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.16.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inches of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.16.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 67 inches from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.16.3 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.16.4 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing pavement in a trench or by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Provide excavation, sheet piling, dewatering, and backfilling for pipeline casings under this section. Install pipeline casing by dry boring and jacking method as follows:

3.16.4.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.16.4.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.16.4.3 Piped Utilities

Provide in casing using wood supports adjusted to obtained grades and elevations indicated.

3.16.4.4 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

3.16.5 Rip-Rap Construction

Construct rip-rap on bedding material in accordance with IDOT State Standard, Gradation RR1, 6” depth in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.16.5.1 Bedding Placement

Spread [filter fabric] bedding material uniformly to a thickness on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.16.5.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.17 EMBANKMENTS

3.17.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 8 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Backfill and fill material must be within the range of -2 to +2 percent of optimum moisture.

Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.18 SUBGRADE PREPARATION

3.18.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping utility installation, scarifying, and compacting, proof roll the subgrade of the buildings and roads with multiple passes of a dump truck loaded with 4 cubic yards of soil or 15 ton, pneumatic-tired roller. Operate the roller/truck in a systematic manner to ensure the passes cover over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with fill and backfill or select material.

3.18.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified.

[After rolling, do not show deviations for the surface of the subgrade for roadways greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area.] Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.18.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 90 percent of laboratory maximum density.

3.18.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.18.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the full depth of the shoulder.

3.18.3.3 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill material or select material to 95 percent of ASTM D698.

3.19 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.20 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.20.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained.

Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.20.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.20.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.21 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 4 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from areas indicated.

3.22 TESTING

Perform testing by a validated commercial testing laboratory or the
Contractor's validated testing facility. Submit qualifications of the validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, validated and approved by the Contracting Officer.

3.22.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.22.2 Select Material Testing

Test select material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.22.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136/C136M for conformance to gradation specified in ASTM C33/C33M.

3.22.4 Density Tests

Test density in accordance with ASTM D1556/D1556M, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556/D1556M density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556/D1556M density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter.

Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 100 linear feet in each 2 feet of trench backfill.

3.22.5 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.22.6 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 5000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.22.7 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.22.8 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.23 DISPOSITION OF SURPLUS MATERIAL

Remove surplus material and excavated unsatisfactory material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber from Government property and properly disposed of in accordance with all applicable laws and regulations.

-- End of Section --

SECTION 31 05 19.13

GEOTEXTILES FOR EARTHWORK

PART 1 GENERAL

The intent of this specification is for the supply and installation of geotextiles underneath the bedding layer for riprap.

1.1 REFERENCES

The publications 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.

ASTM INTERNATIONAL (ASTM)

ASTM D123	(2015b; R 2017) Standard Terminology Relating to Textiles
ASTM D4354	(2012; R 2020) Sampling of Geosynthetics for Testing
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4873/D4873M	(2017) Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D4884/D4884M	(2014a) Strength of Sewn or Thermally Bonded Seams of Geotextiles
ASTM D6241	(2014) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office

that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Geotextiles

Minimum of 60 days prior to the beginning of installation of the same textile

SD-06 Test Reports

Geotextiles
Site Verification

SD-07 Certificates

Geotextiles
Needle Punched Geotextile

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver only approved geotextile rolls to the project site. Label, ship, store, and handle all geotextile in accordance with ASTM D4873/D4873M. Do not use hooks, tongs, or other sharp instruments for handling geotextile.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Provide geotextile that is a woven pervious sheet of plastic yarn as defined by ASTM D123 matching or exceeding the minimum average roll values listed in TABLE 1. Strength values indicated in the table are for the weaker principal direction.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	lb	180	ASTM D4632/D4632M
SEAM STRENGTH	lb	180	ASTM D4632/D4632M
PUNCTURE	lb	370	ASTM D6241
TRAPEZOID TEAR	lb	67	ASTM D4533/D4533M
PERMEABILITY	cm/sec	2.3 min	ASTM D4491/D4491M
APPARENT OPENING SIZE	U.S. SIEVE	60 max	ASTM D4751

PERMITTIVITY	sec -1	0.2 min	ASTM D4491/D4491M
ULTRAVIOLET DEGRADATION	Percent	50 at 500 Hrs	ASTM D4355/D4355M

2.1.2 Geotextile Fiber

Use fibers consisting of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Add stabilizers and/or inhibitors to the base polymer, if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Do not add reclaimed or recycled fibers or polymer to the formulation. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Finish the edges of the geotextile to prevent the outer fiber from pulling away from the geotextile.

2.1.3 Seams

Sew the seams of the geotextile with thread of a material meeting the chemical requirements given above for geotextile yarn or bond the seams by cementing or by heat. Attach the sheets of geotextile at the factory or another approved location, if necessary, to form sections not less than 12 feet wide. Test seams in accordance with method ASTM D4884/D4884M. Seam strength less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction is not permitted.

2.1.4 Securing Pins

Secure the geotextile to the embankment or foundation soil by pins to prevent movement. Other appropriate means to prevent movement such as staples, sand bags, and stone could also be used. Insert securing pins through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Remove securing pins as placement of materials are placed to prevent tearing of geotextile or enlarging holes. Maximum spacing between securing pins depends on the steepness of the embankment slope. Provide maximum pins spacing equal to or less than the values listed in TABLE 2. When windy conditions prevail at the construction site, increase the number of pins upon the demand of the Contracting Officer. Anchor terminal ends of the geotextile with key trench or apron at crest, toe of the slope and upstream and downstream limits of installation.

TABLE 2
MAXIMUM SPACING FOR SECURING PINS

EMBANKMENT	SPACING, feet
STEEPER THAN 1V ON 3H	2
1V ON 3H TO 1V ON 4H	3
FLATTER THAN 1V ON 4H	5

2.2 INSPECTIONS, VERIFICATIONS, AND TESTING

2.2.1 Manufacturing and Sampling

Provide geotextiles and factory seams meeting the requirements specified

in TABLE 1.

2.2.1.1 Conformance Testing

Perform conformance testing in accordance with the manufacturers approved quality control manual. Submit manufacturer's quality control conformance test results.

2.2.1.2 Factory Sampling

Randomly sample geotextiles in accordance with ASTM D4354 (Procedure
Method A). Sample factory seams at the frequency specified in ASTM D4884/D4884M. Provide all samples from the same production lot as will be supplied for the contract, of the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Identify samples submitted for testing by manufacturers lot designation.

2.2.1.3 Needle Punched Geotextile

For needle punched geotextile, provide manufacturer certification that the geotextile has been inspected using permanent on-line metal detectors and does not contain any needles.

2.2.1.4 Manufacturer Certification

All brands of geotextile and all seams to be used will be accepted on the basis of mill certificates or affidavits. Submit duplicate copies of the mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. Attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification.

2.2.2 Site Verification and Testing

Collect samples at approved locations upon delivery to the site at the request of the Contracting Officer. Test samples to verify that the geotextile meets the requirements specified in TABLE 1. Identify samples by manufacturers name, type of geotextile, lot number, roll number, and machine direction. Perform testing at an approved laboratory. Submit test results from the lot under review for approval prior to deployment of that lot of geotextile. Immediately rewrap rolls which are sampled in their protective covering.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Prepare surface, on which the geotextile will be placed, to a relatively smooth surface condition in accordance with the applicable portion of this specification and must be free from obstruction, debris, depressions, erosion feature, or vegetation. Remove any irregularities so as to ensure continuous, intimate contact of the geotextile with all the surface. Remove loose material, soft or low density pockets of material; grade erosion features such as rills and gullies out of the surface before geotextile placement.

3.2 INSTALLATION OF THE GEOTEXTILE

3.2.1 General

Place the geotextile in the manner and at the locations shown. At the time of installation, reject the geotextile if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

3.2.2 Placement

Place the geotextile with the long dimension parallel to the centerline of the channel and laid smooth and free of tension, stress, folds, wrinkles, or creases. Place the strips to provide a minimum width of 12 inches of overlap for each joint. The placement procedure requires that the length of the geotextile be approximately 5 percent greater than the slope length. Adjust the actual length of the geotextile used based on initial installation experience. Temporary pinning of the geotextile to help hold it in place until the bedding layer is placed will be allowed. Remove the temporary pins as the bedding is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Perform trimming in such a manner that the geotextile is not damaged in any way.

3.3 PROTECTION

Protect the geotextile at all times during construction from contamination by surface runoff; remove any geotextile so contaminated and replaced with uncontaminated geotextile. Replace any geotextile damaged during its installation or during placement of bedding materials at no cost to the Government. Schedule the work so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply will require replacement of geotextile. Protect the geotextile from damage prior to and during the placement of riprap or other materials. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Care should be taken to ensure that the utilized cushioning materials will not impede the flow of water. Before placement of riprap or other materials, demonstrate that the placement technique will not cause damage to the geotextile. Do not allow equipment on the unprotected geotextile.

3.4 PLACEMENT OF CUSHIONING MATERIAL

Perform placing of cushioning material in a manner to ensure intimate contact of the geotextile with the prepared surface and with the cushioning material. Do not damage the geotextile, including tear, puncture, or abrasion, during placement. On sloping surfaces place the cushioning material from the bottom of the slopes upward. During placement, the height of the drop of riprap material greater than 12 inches is not permitted. Uncover any geotextile damaged beneath the cushioning material, as necessary, and replaced at no cost to the Government.

3.5 OVERLAPPING AND SEAMING

3.5.1 Overlapping

The overlap of geotextile rolls must be 12 inches. Appropriate measures will be taken to ensure required overlap exists after cushion placement.

3.5.2 Sewn Seams

High strength thread should be used so that seam test conforms to ASTM D4884/D4884M. Provide thread meeting the chemical, ultraviolet, and physical requirements of the geotextile, and provide color different from that of the geotextile. Provide seam strength equal to the strength required for the geotextile in the direction across the seam. Overlapping J-type seams are preferable over prayer-type seams as the overlapping geotextile reduces the chance of openings to occur at the seam. Use double sewing, specially for field seams, to provide a safety factor against undetected missed stitches.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 4150.07 (2019) DOD Pest Management Program

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Herbicide Application Plan

SD-03 Product Data

Tree Wound Paint

Herbicides; G

SD-07 Certificates

Qualifications; G

SD-11 Closeout Submittals

Pest Management Report

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

Comply with State requirements on Contractor's licensing, certification, and record keeping. Maintain daily records and submit weekly.

1.3.2 Qualifications

For the application of herbicides, use the services of an applicator who is commercially certified in the state where the work is to be performed. Submit a copy of the pesticide applicator certificates.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

1.4.1 Storage

Storage of herbicides on the installation will not be permitted unless it is written into the contract.

1.4.2 Handling

Handle herbicides in accordance with the manufacturer's label and Safety Data Sheet (SDS), preventing contamination by dirt, water, and organic material. Protect herbicides from weather elements as recommended by the manufacturer's label and SDS. Spill kits must be maintained on herbicide control vehicles. Mixing of herbicides on the installation will not be permitted unless it is written into the contract.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Tree Wound Paint

Use bituminous based paint from standard manufacture specially formulated for tree wounds.

2.1.2 Herbicide

Provide herbicides currently registered by the EPA or approved for such use by the appropriate agency of the host county and approved by the Contracting Officer. Select a herbicide that is suitable for the climatic conditions at the project site. Submit manufacturer's label and SDS for herbicides proposed for use.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Herbicide Application Plan

Prior to commencing application of herbicide, submit a herbicide application plan with proposed sequence of treatment work including dates and times of application. Include the herbicide trade name, EPA registration number, chemical composition, formulation, application rate of active ingredients, method of application, area or volume treated, and amount applied. Include a copy of the pesticide applicator certificates.

3.1.2 Protection

3.1.2.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2.2 Trees, Shrubs, and Existing Facilities

Provide protection in accordance with Section 01 56 39 TEMPORARY TREE AND PLANT PROTECTION. Protect trees and vegetation to be left standing from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.2.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repair of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION and Section 01 50 00 TEMPORARY FACILITIES AND CONTROLS for additional utility protection.

3.2 APPLICATION

3.2.1 Herbicide Application

Adhere to safety precautions as recommended by the manufacturer concerning handling and application of the herbicide.

3.2.1.1 Clean Up, Disposal, And Protection

Once application has been completed, proceed with clean up and protection of the site without delay. Clean the site of all material associated with the treatment measures, according to label instructions, and as indicated. Remove and dispose of excess and waste material off Government property.

3.2.1.1.1 Disposal of Herbicide

Dispose of residual herbicides and containers off Government property, and in accordance with the approved disposal plan, label instructions and EPA requirements.

3.3 CLEARING

Clearing consists of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing also includes the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Cut off flush with or below the original ground surface trees, stumps, roots, brush, and other vegetation in areas to be cleared, except such trees and vegetation as may be indicated or directed to be left standing. Trim dead branches 1-1/2 inches or more in diameter on trees designated to be left standing within the cleared areas and trim all branches to the heights indicated or directed. Neatly cut close to the bole of the tree or main branches, limbs and branches to be trimmed. Paint, with an approved tree-wound paint, cuts more than 1-1/2 inches in diameter.

3.3.1 Tree Removal

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work includes the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Dispose of trees as specified in paragraph DISPOSAL OF MATERIALS.

3.3.2 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 1-1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4 inches in diameter with an approved tree wound paint.

3.3.3 Grubbing

Grubbing consists of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Fill depressions made by grubbing with suitable material and compact to make the surface conform with the original adjacent surface of the ground.

3.4 DISPOSAL OF MATERIALS

Dispose of excess materials in accordance with the approved solid waste management permit and include those materials in the solid waste management report.

All wood or wood like materials, except for salable timber remaining from clearing, pruning or grubbing such as limbs, tree tops, roots, stumps, logs, rotten wood, and other similar materials shall become the property of the Contractor and disposed of as specified. All non-saleable timber and wood or wood like materials remaining from timber harvesting such as limbs, tree tops, roots, stumps, logs, rotten wood, and other similar materials shall become the property of the Contractor and disposed as specified.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Herbicides

Upon completion of this work, submit the Pest Management Report DD Form 1532, or an equivalent computer product, to the Integrated Pest Management Coordinator. This form identifies the type of operation, brand name and manufacturer of herbicide, formulation, concentration or rate of application used.

-- End of Section --

SECTION 31 25 13

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section pertains to the provisions for the control of erosion in the construction area and in stockpile areas including seeding, the construction of temporary swales and sedimentation basins as required and shown on the drawings. All areas where existing vegetation and grass cover have been bared by construction activities shall be protected from erosion.

B. Contractor is responsible for meeting all local, state and federal regulations regarding erosion control including the applicable provisions of the National Pollution Discharge Elimination System, Phase II, regulations from the Clean Water Act.

C. Construction activity pollution prevention is a mandatory requirement.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including A-Procurement and Contracting Requirements, Division 00 and Division 01 apply to this section.

B. Section 31 00 00 Earthwork

C. Section 31 05 19.13 Geotextiles for Earthwork

D. Section 31 11 00 Clearing and Grubbing

E. Section 32 92 19 Seeding

1.3 DEFINITIONS

A. Best Management Practices (BMP's) means physical facilities schedules of activities, prohibition of practices, maintenance procedures, and other management practices , when properly designed, installed, and maintained, will be effective to prevent or reduce the discharge of pollution associated with construction activities. BMP's also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

B. Block Sodding: Sodding for erosion control and for final stabilization shall consist of providing and planting Bermuda grass, San Augustine grass, or other acceptable sod along or across such areas as are designated on the drawings and in accordance with the specification requirements herein outlined.

C. Hydromulch Seeding: Seeding, followed by the application of a mulch erosion control blanket shall consist of preparing the ground, sowing of seeds, application of a fertilizer, and stabilization with mulch consisting of a biodegradable fiber along and across such areas as are designated on the plans and in accordance with these specifications

D. Silt Fence: The reinforced filter fabric barrier consists of geotextile fabric supported by a net reinforced fence stretched across and attached to supporting posts or frame and entrenched. Work shall be performed during construction operations and prior to final stabilization to control erosion and sedimentation as designated on the plans and in accordance with these specifications.

E. Inlet Protection Barriers: The inlet protection barrier consists of a geotextile fabric (filter fabric) supported by a net reinforced fence structure and constructed around a storm drain inlet, catch basin, or culvert. An alternative design of the inlet protection barrier, as approved by the Engineer, consists of fiber rolls placed around a frame, staked in place (or weighted down with clean gravel bags), and constructed around a storm drain inlet, catch basin or culvert. This work shall be performed during construction operations and prior to final stabilization to control erosion and sedimentation. As designated on the plans and in accordance with these specifications.

F. Sediment Basins: A sediment basin is a temporary basin or dam constructed across a waterway or excavated location to intercept sediment-laden runoff and to trap and retain the sediment. A sediment basin is usually installed at points of discharge from drainage areas greater than 5 acres. Work shall be performed during construction operations and prior to final stabilization to control erosion and sedimentation as designated on the plans and in accordance with these specifications.

G. Stabilized Construction Access: This work shall consist of the installation of temporary erosion protection and sediment control stabilized construction access - type I, rock, utilized during construction operations and prior to final stabilization, in accordance with these specifications and construction drawings.

H. Rock Filter Dams: Rock filter dams are temporary berms constructed of stone to intercept and slow storm water runoff to retain sediment on the construction site.

1. Depending upon the type of rock filter dam specified in the construction plans as Type 1, 2, 3, or 4, the aggregate fill may be unwrapped, wrapped in twisted hexagonal wire mesh, or confined in a gabion wire basket. Applications of RockFilter Dams are as follows:

    a. Type 1 dams may be used at toe of slopes, around inlets, in small ditches, and at dike or swale outlets. Type 1 dams are recommended for erosion and sediment control from a drainage area of 5 acres or less.

    b. Type 2 dams may be used in ditches and at dike or swale outlets.

    c. Type 3 dams may be used in stream flow.

    d. Type 4 sack gabions may be used in ditches and smaller channels to form an erosion and sediment control dam

1.4 QUALITY ASSURANCE

A. Codes and Standards: Install and maintain erosion control systems in compliance with all authorities having jurisdiction.

1.5 SUBMITTALS (NOT USED)

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS

A. Contractor shall strive to utilize sustainable materials, which include rapidly renewable materials, regional materials, regionally manufactured materials, regionally extracted materials, recycled contents.

2.2 SILT FENCE

A. Geotextile fabric for Silt Fences must meet the 31 05 19.13 Geotextiles for Earthwork Requirements.

2.3 STRAW BALES

A. Standard rectangular hay bales bound by baling wire, clean and dry

2.7 INLET PROTECTION BARRIERS

A. Geotextile per 2.2 Silt Fence above.

B. Hardwood Posts shall be 2x2 minimum length 4 feet.

C. Net reinforced fence shall be 2 inch by 4 inch welded wire fabric mesh. The mesh support height shall be the equivalent height, or greater, of the geotextile fabric to be attached.

2.8 STABILIZED CONSTRUCTION ACCESS

A. Materials to be per 32 15 00 Aggregate Surfacing, Table I, No. 1 gradation.

PART 3 - EXECUTION

3.1 GENERAL

A. Protection

1. Protect benchmarks, monuments, existing structures, existing fences, existing roads, existing sidewalks, existing paving, existing curbs, and other features indicated on Drawings to remain, or not indicated to be removed, from damage and displacement. If damaged or displaced, notify Engineer and correct defects as directed.

2. Protect above and below grade utilities which are to remain.

B. Preparation:

1. Use all means necessary to control dust on and near the work, and on and near off-site storage, and spoil areas, if such dust is caused by performance of the work of this Section, or if resulting from the condition in which Project Site is left by Contractor.

2. Moisten surfaces, as required, to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on Project Site.

C. Install erosion control systems at the site's boundary at locations where stormwater runoff will leave the site prior to starting any clearing, stripping, or earthwork operations

D. Minimize the time areas are to be exposed without vegetative cover.

E. Properly dispose of solid waste, paints, solvents, cleaning compounds, etc.

F. Store construction materials in designated areas away from drainageways and low areas.

G. Provide portable toilets and properly dispose of sanitary sewage.

H. Construct containment berms and utilize drip pans at fuel and liquid storage tanks and containers.

3.2 INSTALLATION OF EROSION CONTROL DEVICES

A. Install erosion control devices to protect adjacent and downstream properties from damage and pollution resulting from erosion caused by the work of this Contract.

1. Implement erosion control measures indicated on drawings and additional erosion control measures necessary to prevent damage to adjacent and downstream properties.

B. Install silt fence located along perimeter of site or grading limits immediately following site clearing operations specified under Division 31 Section 31 11 00 Clearing and Grubbing.

1. Install silt fence fabric from a continuous roll for the length of the silt fence whenever possible to minimize the number of joints.

a. Create joints in fabric by securely fastening fabric at the support post with overlap extending to the next post.

2. Drive support post into ground not less than 18 inches.

3. Excavate a 4 inch wide by 4 inch deep trench on up-slope side of silt fence.

a. Line trench with silt fence fabric material.

b. Backfill trench with soil or gravel.

C. Install straw bale fence at completion of grading operations in affected area as indicated on drawings.

1. Install erosion control devices at storm sewer inlets immediately after completion of the storm sewer.

2. Place straw bales in a single row, lengthwise on the contour, and embedded 4 inches into soil.

3. Secure each individual bale in place by stakes or reinforcement bars driven through bales into the ground to a depth of not less than 18 inches.

D. Install inlet protection barriers at curb inlets and at area inlets.

E. Install straw bale fences as ditch checks in drainage ditches.

F. Install Stabilized Construction Access minimum 15' wide by 70' long at main construction vehicle access point to a minimum of 8" in depth.

3.3 EROSION CONTROL SEEDING

A. Exposed fill and stockpile areas shall be protected from windborne erosion if the phasing of the construction operations is anticipated to leave the exposed fill and stockpile areas unattended for 6 weeks or more. At completion of stockpiling operations, stockpiles shall be shaped and graded to drain. Provide a layer of mulch to all sides of the stockpile to protect the stockpile from windborne erosion.

B. Areas designated on the drawings to be seeded shall be seeded in accordance with 32 92 19 Seeding. Broadcast seeding method shall be used as described unless otherwise instructed.

3.4 TEMPORARY SWALES

A. Temporary drainage swales shall be provided as required to carry drainage away from the work area to an approved outfall point.

B. Unless otherwise shown on the drawings, swales shall be earthen "V" shaped channels graded to a sufficient depth and slope to carry the anticipated runoff, but at least two (2) feet deep with a slope of 0.1%.

C. Swales not designated to remain in place at the completion of the contract shall be cleaned of any muck, debris and other unsuitable material and filled with approved fill before final grading operations begin.

D. Swales shall have erosion control barriers as required in these specifications.

3.5 FILL AND CUT SLOPES

A. Fill slopes in all cases shall be no steeper than 3:1 unless specifically stated on the plans or approved by the Owner's Geotechnical engineer.

B. When cut slopes exceed 2:1 for depths over three (3) feet, proper bracing and shoring per OSHA requirements shall be used and maintained.

C. For permanent slopes, cut or fill, between 2:1 and 10:1, erosion protection shall be provided with hydromulching seeding, sodding, or other method as approved.

D. Where cut slopes of more than 5 feet deep, extend more than 100 feet in length, contractor shall provide a backfill drain at the top of the slope to ease in drainage and erosion control.

3.6 SEDIMENTATION BASINS

A. Sedimentation ponds shall be provided when designated on the plans.

B. All drainage from cleared areas shall be routed through the sedimentation basin.

C. Contractor will be responsible for the operation and maintenance of the pond during construction.

3.7 MAINTENANCE

A. Check all erosion control measures after each rainfall event to ensure that they are in proper working order.

1. Immediately restore all measures to installed condition.

2. During the course of construction all temporary swales constructed for this contract shall be maintained so as to allow proper drainage from the construction area. Before Contractor leaves the site at the end of construction, all temporary swales must be reworked to meet final conditions as set forth in the drawings and specifications.

3. The Contractor shall assure that all subwork with other contractors at the site understand the importance of the erosion control features. The Contractor shall require all subcontractors to respect the function of the erosion control features and enlist their coordination in maintaining existing swales and ditches

B. Inspect silt and straw bale fences at least once a week.

1. Immediately replace damaged portions of the silt fences, including portions which have collapsed, contain tears, have decomposed, or have become ineffective.

2. Remove sediment deposits, as necessary, to provide adequate sediment storage and to maintain the integrity of fences. Dispose of accumulated sediment by spreading over upland areas of the site.

C. Maintain erosion control devices in place, as specified, until completion of the work of this Contract.

1. At completion of work, inspect all systems, make necessary repairs, remove and dispose of all accumulated sediment, and turn completely operable systems over to Owner for continued maintenance.

D. Where necessary for equipment and vehicular access to the work areas, adequately sized culverts shall be installed and maintained to provide the access without disturbing the site drainage.

E. Sedimentation Basins.

1. Contractor shall be responsible for maintaining the pond and the outfall and sediment retarding structure in good working condition throughout the time the pond is to be in operation.

2. When sediment and debris fill the pond to over one third (1/3) its designed capacity, the pond shall be cleaned out.

3. The sediment from the clearing operation shall be stockpiled with like materials per Specification 31 11 00 Clearing and Grubbing. If the material is found to not meet the stockpiling requirements listed in 31 11 00, they must be removed from the site as described in 31 11 00.

3.8 INSPECTIONS

A. Inspect all erosion control systems and devices at least once every seven calendar days.

B. Inspect all erosion control systems and devices within 24 hours of the end of any storm which results in precipitation of 1/2 inch or more.

C. During inspections, locations where stormwater leaves the site shall be inspected for evidence of erosion or sediment deposition.

D. Correct deficiencies within three calendar days.

E. Complete a report of each inspection. Report shall contain the following minimum information:

1. Inspector's name

2. Inspection date

3. Observations of the effectiveness of erosion control systems

4. Actions taken if necessary to correct deficiencies

5. Listing of areas where construction operations have permanently or temporarily stopped

6. Authorized signature

END OF SECTION

SECTION 32 15 00

AGGREGATE SURFACING

PART 1 GENERAL

1.1 WAYBILLS AND DELIVERY TICKETS

Submit copies of waybills and delivery tickets during progress of the work. Before the final payment is allowed, file certified waybills and certified delivery tickets for all aggregates actually used.

1.2 REFERENCES

The publications 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM E11	(2022) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.3 DEGREE OF COMPACTION

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools; G

Waybills And Delivery Tickets

SD-06 Test Reports

Initial Tests; G

In-Place Tests; G

1.5 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.6 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 40 00.00 QUALITY REQUIREMENTS. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.6.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Testing

1.6.2.1 Sieve Analysis

Perform sieve analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11.

1.6.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.6.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with paragraph DEGREE OF COMPACTION.

1.6.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167 or ASTM D6938. For the method presented in ASTM D1556/D1556M use the base plate as shown in the drawing. For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. Also check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. Make the calibration checks of both the density and moisture gauges using the prepared containers of material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

1.6.2.5 Wear Test

Perform wear tests on aggregate surface course material in conformance with ASTM C131/C131M.

1.7 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F.

It is the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Bring surfaces damaged by freeze, rainfall, or other weather conditions to a satisfactory condition.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Provide aggregates free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor is responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction operations have been completed.

2.1.1 Coarse Aggregates

The material retained on the No. 4 sieve is known as coarse aggregate. Use only coarse aggregates that are reasonably uniform in density and quality. Use only coarse aggregate having a percentage of wear not exceeding 50 percent after 500 revolutions as determined by ASTM C131/C131M. The amount of flat and/or elongated particles must not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source must meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the No. 4 sieve is known as fine aggregate. Fine aggregate consists of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements specified in TABLE I apply to the completed aggregate surface. It is the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads. Use sieves conforming to ASTM E11.

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES Percentage by Weight Passing Square-Mesh Sieve				
Sieve Designation	No. 1	No. 2	No. 3	No. 4
1 inch	100	100	100	100
3/8 inch	50-85	60-100	--	--
TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES				

Percentage by Weight Passing Square-Mesh Sieve				
Sieve Designation	No. 1	No. 2	No. 3	No. 4
No. 4	35-65	50-85	55-100	70-100
No. 10	25-50	40-70	40-100	55-100
No. 40	15-30	24-45	20-50	30-70
No. 200	8-15	8-15	8-15	8-15

2.2 LIQUID LIMIT AND PLASTICITY INDEX

The portion of the completed aggregate surface course passing the No. 40 sieve must have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.

a. Sieve Analysis.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Finalize aggregate sources on private lands in agreement with local laws or authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling the material, clear and level the storage sites. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates in such a manner that will prevent segregation.

Stockpile aggregates and binders obtained from different sources separately.

3.3 PREPARATION OF UNDERLYING SUBGRADE

Clean the subgrade and shoulders of all foreign substances. Do not construct the surface course on subgrade that is frozen material. Correct ruts or soft yielding spots in the subgrade, areas having inadequate compaction and deviations of the surface from the requirements set forth herein by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompacting to density requirements specified in Section 31 00 00 EARTHWORK. Do not allow traffic or other operations to disturb the completed subgrade and maintain in a satisfactory condition until the surface course is placed.

3.4 GRADE CONTROL

During construction, maintain the lines and grades including crown and cross slope indicated for the aggregate surface course by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CONTRACT REQUIREMENTS.

3.5 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material and a uniform optimum water content for compaction. Make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

3.6 LAYER THICKNESS

Place the aggregate material on the subgrade in layers of uniform thickness. Compact the completed aggregate surface course to the thickness indicated. No individual layer may be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. Compact the aggregate surface course to a total thickness that is within 1/4 inch of the thickness indicated. Where the measured thickness is more than 1/4 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/4 inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 1/4 inch of the thickness indicated. Measure the total thickness of the aggregate surface course at intervals of one measurement for each 500 square yards of surface course. Measure total thickness using 3 inch diameter test holes penetrating the aggregate surface course.

3.7 COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated herein as percent laboratory maximum density. Compact each layer of the aggregate surface course with approved compaction equipment, as required in the following paragraphs. Maintain the water content during the compaction procedure at optimum or at the percentage specified by the Contracting Officer.

Compact the mixture with mechanical tampers in locations not accessible to rollers. Continue compaction until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Remove any materials that are found to be unsatisfactory and replace them with satisfactory material or rework them to produce a satisfactory material.

3.8 EDGES OF AGGREGATE SURFACE COURSE

Place approved material along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. Simultaneously roll and compact at least 1 foot of shoulder width with the rolling and compacting of each layer of the surface course when the course is being constructed in two or more layers.

3.9 SMOOTHNESS TEST

Construct each layer so that the surface shows no deviations in excess of 3/8 inch when tested with a 10 foot straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Correct deviations exceeding this amount by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.10 FIELD QUALITY CONTROL

3.10.1 In-Place Tests

Perform each of the following tests on samples taken from the placed and compacted aggregate surface course. Take samples and test at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of the aggregate surface course at intervals providing at least one measurement for each 500 square yards of base course or part thereof. Measure the thickness using test holes, at least 3 inch in diameter through the aggregate surface course.

3.10.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and full compacted aggregate surface course.

3.11 MAINTENANCE

Maintain the aggregate surface course in a condition that will meet all specification requirements until accepted.

-- End of Section --

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants

ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Biodegradable Form Release Agent

SD-06 Test Reports

Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Contracting Officer access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.3.2 Slip Form Equipment

Slip form paver or curb forming machines, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat mixing water and aggregates as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete must have a minimum compressive strength of 4000 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 3 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slipformed concrete as determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Use burlap conforming to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Use hard-pressed fiberboard contraction joint filler for curb and gutter.

2.4.2 Expansion Joint Filler, Premolded

Onless otherwise indicated, use 1/2 inch thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.5 JOINT SEALANTS

Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.6.5 Biodegradable Form Release Agent

Use form release agent that is colorless and biodegradable and that is composed of at least 87 percent biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.7 Detectable Warning System

Detectable Warning Systems shown on the Contract plans are to meet requirements of ICC A117.1 - Section 705.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section by means of a template extending the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment must be checked with a 10 foot straightedge. Sidewalks must have a transverse slope of 1/4 inch per foot. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of all sidewalks 10 feet or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8 inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.5.3 Reinforcement Steel Placement

Accurately and securely fasten reinforcement steel in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Construct contraction joints directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Construct contraction joints (except for slip forming) by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Remove separators as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, cut the contraction joints in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. Cut the contraction joint to a depth of at least one-fourth of the gutter/curb depth using a 1/8 inch saw blade.

3.6.2 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 1/2 inch in width at intervals not less than 30 feet nor greater than 120 feet. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 1 inch depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 50 degrees F at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.7.4 Protective Coating

Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

3.7.4.1 Application

Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive

strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing foreman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 1/4 inch. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

3.10 DETECTABLE WARNING SYSTEM

Install Detectable Warning Systems required by Contract plans in accordance with ICC A117.1, Section 705, and by manufacturers' installation instructions.

-- End of Section --

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK and Section 31 11 00 CLEARING AND GRUBBING applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer Include physical characteristics, and recommendations.

SD-07 Certificates

State Certification and Approval for Seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed and Fertilizer Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles. 1.6 TIME

RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Planting Dates

Planting Season	Planting Dates _____
Season 1	April 1st - June 15th

Season 2	August 1st - October 15th
Temporary Seeding	Rest of year if ground not frozen.

Seasons 1 & 2 = No-Mow seed mixture, (to be used on all of site that isn't landscaping).

Species	Purity Minimum %	Germination Minimum %	Mixture Percent by Weight
SR3150 Hard Fescue	97	85	25
Longfellow #3 Chewings Fescue	97	85	25
Quatro Sheep Fescue	97	85	25
Maxima Red Fescue	97	85	12
Samanta Slender Creep Red Fescue	97	85	13

Seasons 1&2 = WI DOT Mix No. 30, (salt tolerant lawn mixture to be used only if/where designated by Contracting Officer or called for on plans).

Species	Purity Minimum %	Germination Minimum %	Mixture Percent by Weight
Kentucky Bluegrass	98	85	10
Red Fescue	97	85	30
Hard Fescue	97	85	25
Salt Grass	98	85	15
Improved Fine Perennial Ryegrass	96	85	20
Temporary Seeding			
Annual Oats	98	90	30
Agricultural Rye	97	85	40

Seasons 1&2 = WI DOT Mix No. 30, (salt tolerant lawn mixture to be used only if/where designated by Contracting Officer or called for on plans).

Species	Purity Minimum %	Germination Minimum %	Mixture Percent by Weight
Winter Wheat	95	90	30

2.1.3 Seed Mixture by Weight

Proportion seed mixtures by weight. Temporary seeding must later be replaced by Season 1 plantings for a permanent stand of grass. The same requirements of turf establishment for Season 1 apply for temporary seeding.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site in accordance with Section 31 00 00 EARTHWORK.

2.3 FERTILIZER

2.3.1 Granular Fertilizer

Organic or synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

16 percent available nitrogen
6 percent available phosphorus
24 percent available potassium

2.3.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients.

16 percent available nitrogen 6 percent
available phosphorus
24 percent available potassium

2.4 MULCH

Mulch must be free from noxious weeds, mold, and other deleterious materials.

2.4.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw must contain no fertile seed.

2.5 WATER

Source of water must be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

2.6 EROSION CONTROL MATERIALS

If erosion is occuring and the Contracting Officer determines that slopes need additional erosion control, then erosion control material must conform to the following:

2.6.1 Erosion Control Blanket

100 percent agricultural straw or 70 percent agricultural straw/30 percent coconut fiber matrix stitched with a degradable nettings, designed to degrade within 12 months.

2.6.2 Erosion Control Fabric

Fabric must be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips must have a minimum life of 6 months.

2.6.3 Erosion Control Net

Net must be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately one inch square.

2.6.4 Hydrophilic Colloids

Hydrophilic colloids must be physiologically harmless to plant and animal life without phytotoxic agents. Colloids must be naturally occurring, silicate powder based, and must form a water insoluble membrane after curing. Colloids must resist mold growth.

2.6.5 Erosion Control Material Anchors

Erosion control anchors must be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation prior to planting, fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following: Organic Granular Fertilizer 7 pounds per 1000 square feet.

Synthetic Fertilizer 7 pounds per 1000 square feet.

Hydroseeding Fertilizer 7 pounds per 1000 square feet.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method may be broadcasted and drop seeding, drill seeding, or hydroseeding.

3.2.2.1 Broadcast and Drop Seeding

Seed must be uniformly broadcast at the rate of 2 pounds per 1000 square feet. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 Drill Seeding

Seed must be drilled at the rate of 2 pounds per 1000 square feet. Use cultipacker seeders or grass seed drills. Drill seed uniformly to average depth of 1/2 inch.

3.2.2.3 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper must be applied as part of the hydroseeding operation. Fiber must be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed must be mixed to ensure broadcasting at the rate of 2 pounds per 1000 square feet. When hydraulically sprayed on the ground, material must form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch must be spread uniformly at the rate of 2 tons per acre. Mulch must be spread by hand, blower-type mulch spreader, or other approved method. Mulching must be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch must not be bunched or clumped. Sunlight must not be completely excluded from penetrating to the

ground surface. All areas installed with seed must be mulched on the same day as the seeding. Mulch must be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor must be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.3.3 Non-Asphaltic Tackifier

Hydrophilic colloid must be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture must be applied over the area.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERAGE

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2021) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

ASTM INTERNATIONAL (ASTM)

ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C972	(2000; R 2011) Compression-Recovery of Tape Sealant
ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1244	(2020) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	(2000; R 2020) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2412	(2021) Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	(2021) Polyethylene Plastics Pipe and Fittings Materials
ASTM D4101	(2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F714	(2022) Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F894	(2019) Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	(Nov 2016) Scaffolds and Roope Descent Systems

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's License; G

SD-02 Shop Drawings

Installation Drawings; G, AE

SD-03 Product Data

Precast Concrete Manholes Frames, Covers,

and Gratings

Gravity Pipe

Pressure Pipe

SD-06 Test Reports Precast Concrete Sewer Manhole Test; G

Hydrostatic Sewer Test; G

Negative Air Pressure Test; G

Low-Pressure Air Tests; G

Tests For Pressure Lines; G

Deflection Testing

SD-07 Certificates

Portland Cement

Gaskets

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Verify installing Contractor's License is current and state certified or state registered.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.4.1.3 Valves

Maintain valve end protection. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe in accordance with the

manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded. Use sling to handle large valves. Rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals 8 inch and 10 inch lines of polyvinyl chloride (PVC) plastic pipe. Provide building connections 4 inch and 6 inch lines of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

2.1.2 Sanitary Sewer Pressure Lines

Provide pressure lines of High Density Polyethelyne Pipe (HDPE) or polyvinyl chloride (PVC) plastic pressure pipe.

2.1.3 Valves

a. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

b. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

c. Valve Actuators:

1. Chainwheel: For valves located 6’ or more above floor level.

2. Gear Drive: For quarter turn valves NPS 8 and larger and gate valves larger than 12 inches.

3. Handwheel: For non-buried valves other than quarter turn types.

4. Lever Handle: For quarter turn valves NPS 6 and smaller, except plug valves.

5. Wrench: For plug valves and gate valves with square heads. Furnish Owner with 1 wrench for every 10 valves, for each size square plug head.

6. Electric Valve Actuators: for actuation of resilient-seated, cast iron, eccentric plug valves. Direct drive, quarter-turn actuator. Single phase, 60 Hz, 120V power supply.

2.1.3.1 Gate Valves 3 Inch Size and Larger on Buried Piping

Nonrising stem type with mechanical-joint ends and resilient-seated gate valves 3 to 12 inches in size.

Gate valves open by counterclockwise rotation of the valve stem. Stuffing boxes have 0-ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of 0-ring

seal. Stuffing boxes are bolted and constructed so as to permit easy removal of parts for repair. Use gate valves with special ends for connection to sleeve-type mechanical coupling in lieu of mechanical-joint ends and push-on joint ends. Provide valve ends and gaskets for connection to sleeve-type mechanical couplings that conform to the requirements specified respectively for the joint or coupling. Provide all valves from one manufacturer.

2.1.3.2 Gate Valves 3 Inch Size and Larger in Valve Pit(s) and Aboveground Locations Nonrising stem type with flanged ends.

Gate valves are nonrising stem type or inside-screw type. Gate valves are solid-wedge gates or solid or one-piece type gates. Provide gate valves with handwheels that open by counterclockwise rotation of the valve stem. Bolt and construct stuffing boxes so as to permit easy removal of parts for repair. Provide all valves from one manufacturer.

2.1.3.3 Swing Check Valves

Provide check valves with a clear port opening. Provide non-clog, full flow, fullbody rubber flapper non-slam check valves. Top access port shall be full size allowing for removal of the disc without removing the valve from the pipe. Provide all check valves from the same manufacturer.

2.1.3.4 Resilient-Seated, Cast Iron, Eccentric Plug Valves

Resilient seating material to be suitable for raw, unscreened sewage service and sludge applications. Unless otherwise indicated: Welded Nickel (90%). Round ports equal to a minimum of 90 percent of full-flow area when valve is fully open. Radial bearings to be stainless steel. Thrust bearings to be constructed of teflon and stainless steel. Compression molded, one piece plug design. Pressure rating: 175 psi. Valve interior should be factory coated with sewage resistant coating. Refer to drawings for nominal valve diameter.

2.2 MATERIALS

Provide materials conforming to the respective specifications and other requirements specified below. Submit manufacturer's product specification,standard drawings or catalog cuts.

2.2.1 Gravity Pipe

2.2.1.1 PVC Gravity Sewer Piping

2.2.1.1.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, or ASTM F949 with ends suitable for elastomeric gasket joints.

2.2.1.1.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 Pressure Pipe

2.2.2.1 PVC Pressure Pipe and Associated Fittings

Pipe, couplings and fittings are to be manufactured of materials

conforming to ASTM D1784, Class 12454B.

2.2.2.1.1 Pipe and Fittings 4 inch Diameter And Larger

Provide pipe conforming to AWWA C900 and be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings are to be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and AWWA C111/A21.11 with a cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings for pipe to pipe push-on joint ends are to conform with AWWA C900.

2.2.2.2 High Density Polyethylene Pipe (HDPE)

ASTM F894, Class 63, size 18 inch through 120 inch. ASTM F714, size 4 inch through 48 inch, will have pipe stiffness greater than or equal to 1170/D for cohesionless material pipe trench backfills. For all PE pipes, the polyethylene are to be certified by the resin producer as meeting the requirements of ASTM D3350, cell Class 334433C or higher. Fittings for High Density Polyethylene Pipe are to meet the same material specifications as the pipe class. Joints for HDPE meeting ASTM F894 will be rubber gasket joints conforming to ASTM F477. HDPE meeting ASTM F714 will have fused joints in accordance with manufacturer's instruction.

2.2.3 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of precast manholes. Provide portland cement conforming to ASTM C150/C150M, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.2.4 Portland Cement Concrete

Provide portland cement concrete conforming to ASTM C94/C94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement is to have a compressive strength of 2500 psi minimum at 28 days. Protect concrete in place from freezing and moisture loss for 7 days.

2.2.5 Cleanouts

Same nominal size and material as the pipes they serve, except 4 inch cleanouts in pipes 4 inches and larger; unless shown otherwise.

2.2.6 Precast Concrete Manholes

Provide precast concrete manholes, risers, base sections, and tops conforming to ASTM C478 and be manufactured in accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser are to be monolithic.

2.2.7 Gaskets and Connectors

Provide gaskets for joints between manhole sections conforming to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole are to conform ASTM C923 or ASTM C990.

2.2.8 External Preformed Rubber Joint Seals

An external preformed rubber joint seal is an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" are to be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal is to be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit is to consist of a top and bottom section and have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic is to be a non-hardening butyl rubber sealant and seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections are to cover up to two more adjusting rings. Properties and values are listed in the following table:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals				
Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, psi	ASTM D412	1840	2195	--
Elongation, percent	ASTM D412	553	295	350
Tear Resistance, ppi	ASTM D624 (Die B)	280	160	--
Rebound, percent, 5 minutes	ASTM C972 (mod.)	--	--	11
Rebound, percent, 2 hours	ASTM C972	--	--	12

2.2.9 Frames, Covers, and Gratings for Manholes

Frame and cover are to be cast ductile iron, ASTM A536, Grade 65-45-12.
Frames and covers are to be circular with vent holes. Size are to be for 24 inch opening. Stamp or cast the words "Sanitary Sewer" into covers so that it is plainly visible.

2.2.10 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27 with a plastic or rubber coating pressure-molded to the steel is to be used. Provide plastic coating conforming to ASTM D4101, copolymer polypropylene. Rubber is to conform to ASTM C443, except shore A durometer hardness is to be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Installation Drawings

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

3.2 INSTALLATION

Backfill after inspection by the Contracting Officer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

3.2.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.1.1 Location

Terminate the work covered by this section at a point approximately 5 feet from the building. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. When these separation distances can not be met, contact the Contracting Officer for direction. 3.2.1.1.1 Sanitary Piping Installation Parallel with Water Line

3.2.1.1.1.1 Normal Conditions

Install sanitary piping or manholes at least 10 feet horizontally from a water line whenever possible. Measure the distance from edge-to-edge.

3.2.1.1.1.2 Unusual Conditions

When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

a. The top (crown) of the sanitary piping is to be at least 18 inches below the bottom (invert) of the water main.

b. Where this vertical separation cannot be obtained, construct the sanitary piping with AWWA-approved PVC water main quality pipe and conduct a hydrostatic sewer test without leakage prior to backfilling.

c. The sewer manhole is to be of watertight construction and tested in place.

3.2.1.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.1.1.2.1 Normal Conditions

Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

3.2.1.1.2.2 Unusual Conditions

When local conditions prevent a vertical separation described above, use the following construction:

a. Construct sanitary piping passing over or under water lines with AWWA-approved PVC water main quality pipe and conduct a hydrostatic sewer test without leakage prior to backfilling.

b. Protect sanitary piping passing over water lines by providing:

(1) A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

(2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3) That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints are equidistant and as far as possible from the water line.

3.2.1.1.3 Cleanouts

a. Cleanouts shall be installed on service laterals where there is a change in direction with a horizontal wye and a 90 degree vertical elbow to pipe to the surface.

b. Have locations approved for cleanouts in finished areas except where shown on Drawings.

c. Make cleanouts accessible.

d. Thoroughly graphite cleanout threads after tests are made and approved.

3.2.1.1.4 Sanitary Sewer Manholes

No water piping must pass through or come in contact with any part of a sanitary sewer manhole.

3.2.1.1.5 Valves

a. Piping installation requirements are specified in this section. Drawings indicate general arrangement of piping, fittings, and specialties.

b. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

c. Locate valves for easy access and provide separate support where necessary.

d. Where possible, install valves in horizontal piping with stem at or above center of pipe.

e. Install valves in position to allow full stem movement.

f. Install check valves for proper direction of flow.

3.2.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.2.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Construct branch connections by use of regular fittings or solvent cemented saddles as approved. Provide saddles for PVC pipe conforming to Table 4 of ASTM D3034.

3.2.2 Special Requirements

3.2.2.1 Installation of PVC Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.2.2 Installation of PVC Pressure Pipe

Unless otherwise specified, install pipe and fittings in accordance with AWWA C605. AWWA C605 includes requirements such as excavation, installation, and placement of appurtenances.

3.2.2.2.1 Pipe 4 inch Diameter And Larger

Make push-on joints with AWWA C900 pipe with integral elastomeric gasket. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel. For push-on joint connections to fittings, use cut spigot end of pipe off square, marked to match the manufacturer's insertion line and beveled to match factory supplied bevel. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints or flanged joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories or with the applicable requirements of AWWA C600 for ductile iron joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for mechanical-joint or flanged joint connections and do not bevel.

3.2.2.2.2 Pipe Anchorage

Provide concrete thrust blocks (reaction backing) for pipe anchorage.
Size and position thrust blocks as indicated. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.2.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. Support the pipe on a concrete cradle, or encased in concrete where indicated or directed.

3.2.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Perform cast-in-place concrete work in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.2.5 Miscellaneous Construction and Installation

3.2.5.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are to be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.

3.2.5.2 Metal Work

3.2.5.2.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.3 FIELD QUALITY CONTROL

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

Perform field tests and provide labor, equipment, and incidentals required for testing.

3.3.1.1 Hydrostatic Sewer Test

When unusual conflicts are encountered between sanitary sewer and waterlines a hydrostatic pressure sewer test will be performed in accordance with the applicable AWWA standard for the piping material or AWWA C600 with a minimum test pressure of 20.

3.3.1.2 Leakage Tests for Nonpressure Lines

Test lines for leakage by either negative air pressure tests or by low-pressure air tests. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.3.1.2.1 Negative Air Pressure Test

3.3.1.2.1.1 Precast Concrete Manholes

Test precast concrete sewer manhole test in accordance with ASTM C1244. The allowable vacuum drop is located in ASTM C1244 Make calculations in accordance with the Appendix to ASTM C1244.

3.3.1.2.2 Low-Pressure Air Tests

3.3.1.2.2.1 PVC Pipelines

Test PVC pipe in accordance with UBPPA UNI-B-6. The allowable pressure drop is located in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.3.1.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified

in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3.1.3.1 PVC Pressure Pipe

Test PVC pressure pipe in accordance with the requirements of AWWA C605 for hydrostatic and leakage tests. The quantity of water that must be supplied during testing is not to exceed the quantity of water calculated in accordance with AWWA C605 to maintain the specified test pressure within 5 psi.

3.3.1.4 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D2412. Deflection of pipe in the installed pipeline under external loads is not to exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device.

3.3.1.4.1 Pull-Through Device

This device is to be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Space circular sections on the shaft so that the distance from external faces of front and back sections will equal or exceed the diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections are to conform to the following:

a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

b. Homogeneous material throughout, is to have a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

c. Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

d. Suitably Back each eye or loop with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3.3.1.4.2 Pull-Through Device Procedure

Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

3.3.2 Field Tests for Cast-In-Place Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3.3 Adjusting for Valves

Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3.4 Inspection

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; the light must show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

-- End of Section --

SECTION 33 31 00.13

ABANDONMENT OF SEWER MAINS

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

ASTM INTERNATIONAL (ASTM)

ASTM C940	(2016) Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.2 SECTION INCLUDES

Abandonment in place, by cutting and capping, of existing sewers, junction structures, manholes, service lines, and force mains.

Abandonment in place of existing sewers and force mains using flowable fill. Flowable fill will be utilized when abandoning existing sewers and force mains underneath roadways and paved areas and at the direction of the Contracting Officer as field conditions dictate, or as specified on the Drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plugs Submit product data for proposed plugs for approval. SD-10 Operation

and Maintenance Data

Equipment

Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

Abandonment

At least 15 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

PART 2 PRODUCTS

2.1 PLUGS

a. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C1107/C1107M, Grade B or C.

b. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

2.2 FLOWABLE FILL REQUIREMENTS

a. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

b. Placement characteristics: self -leveling.

c. Shrinkage characteristics: non-shrink.

d. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C940.

e. Minimum wet density: 90 pounds per cubic foot.

2.3 BALLAST

a. Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.

b. Ballast Composition: Free of regulated waste material.

PART 3 EXECUTION

3.1 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT

a. Remove manhole frames and covers and castings from other existing pipeline structures. Properly dispose of castings per 02 41 00 DEMOLITION. Alternatively, salvaged castings may be used upon approval by the Contracting Officer, for constructing new manholes on this project.

b. Demolish and remove precast concrete adjustment rings and corbel section, or brick and mortar corbel and chimney, or other pipeline structures, to minimum depth of 6 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.

c. Drain manholes and poke holes in manhole floors and walls prior to filling.

d. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.

e. Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to the specification section for Excavation and Backfill or Utilities. Cut existing force main, when necessary, to

provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

3.2 CUTTING AND CAPPING OF MAINS

a. Do not begin cut, plug, and abandonment operations until replacement sewer or force main, has been constructed and tested, all service connections have been installed, and main has been approved for use.

b. Install plug, clamp, and concrete reaction block and make cut at location shown on Drawings and/or as directed by Contracting Officer.

c. Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on Drawings.

d. After main to be abandoned has been cut and capped, check for other sources feeding abandoned sewer main. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

e. Plug or cap ends or opening in abandoned main in manner approved by Contacting Officer. Install concrete around cap and over pipe to ensure it is not penetrable by groundwater.

f. Remove and dispose of surface identifications such as cleanouts. Clean-outs in improved streets, shall be filled with concrete.

g. Backfill excavations in accordance with Section 31 00 00 EARTHWORK.

h. Repair street surfaces in accordance with project specifications.

i. Mark location of abandoned sewer laterals on Drawings and provide to the Contracting Officer.

3.3 CUTTING AND CAPPING OF SERVICES

a. Do not begin cut, plug, and abandonment operations until replacement service, if necessary, has been constructed and tested, and all service connections have been installed.

b. Service lines shall be cut and capped at the sewer main and/or as directed by Contracting Officer.

c. Before backfilling of a capped service line is started, the capping must be observed by a representative of the Contracting Officer.

d. After service to be abandoned has been cut and capped, check for any other sources feeding abandoned sewer service. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

e. Plug or cap ends or opening in abandoned service in manner approved by Contracting Officer. Install concrete around cap and over pipe to ensure it is not penetrable by groundwater.

f. Remove and dispose of surface identifications such as cleanouts. Cleanouts in improved streets, shall be filled with concrete.

g. Backfill excavations in accordance with Section 31 00 00 EARTHWORK.

h. Repair paved surfaces in accordance with project specifications.

i. Mark location of abandoned sewer laterals on Drawings and provide to Contracting Officer.

3.4 ABANDONMENT OF FORCE MAINS

a. Do not begin cut, plug, and abandonment operations until replacement force main has been constructed and tested, and all service connections have been installed.

b. Install plug, clamp, and concrete reaction block and make cut at location shown on Drawings.

c. Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on Drawings.

d. After force main to be abandoned has been cut and plugged, check for other sources feeding abandoned force main. When sources are found, notify Contracting Officer immediately. Cut and plug abandoned force main at point of other feed as directed by Contracting Officer.

e. Plug or cap ends or openings in abandoned force main in manner approved by Contracting Officer.

f. Remove surface identifications and appurtenances such as valve boxes.

g. Backfill excavations in accordance with Section 31 00 00 EARTHWORK.

h. Repair street surfaces in accordance with project specifications.

3.5 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

a. Have fill mix design reports and other submittals required by Paragraph 2.2 accepted by the Contracting Officer prior to start of placement. Notify the Contracting Officer at least 24 hours in advance of grouting with flowable fill.

b. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.

c. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project and report them to the Contracting Officer. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

d. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.

e. Remove free water prior to starting fill placement.

3.6 EQUIPMENT FOR FLOWABLE FILL

a. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.

b. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.7 INSTALLATION OF FLOWABLE FILL

a. Abandon existing sewer lines and force mains as called out on plans by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.

b. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

c. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

d. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.

e. Pump flowable fill through bulkheads constructed for placement of two 2 -inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

f. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.

g. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.

h. Remediate placement of flowable fill which does not fill voids in sewer, in force main, and in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.

i. Plug each end of force main being abandoned, if not filled with flowable fill.

j. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.

k. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.

l. When using manufactured plug or cap, install fitting as recommended by manufacturer's instructions, to form water-tight seal.

m. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 00 00 EARTHWORK.

n. Collect and dispose of excess flowable fill material and other debris in accordance with local requirements or as directed by the Contracting Officer.

3.8 PROTECTION OF PERSONS AND PROPERTY

a. Provide safe working conditions as required by OSHA and applicable State and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

b. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to Work.

-- End of Section --

SECTION 33 40 00

STORMWATER UTILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 294	(2021) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM C76	(2020) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C76M	(2020) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C270	(2019a; E 2019) Standard Specification for Mortar for Unit Masonry
ASTM C443	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478/C478M	(2020) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	(2022) Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F794	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2019) Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2620	(2020a; E 2021) Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office

that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Frame and Cover or Gratings; G

SD-08 Manufacturer's Instructions

Placing Pipe and Culvert; G

SD-11 Closeout Submittals

LID Verification Report; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Inspect materials delivered to site for damage and unload and store materials with minimal handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings free of dirt and debris. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe in accordance with the manufacturer's recommendations and discard if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

1.3.2 Handling

Handle materials in a manner that ensures delivery to the trench in sound, undamaged condition. Carry pipe to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe sizes for culverts and storm drains are indicated on the drawings.

2.1.1 Concrete Pipe

2.1.1.1 Reinforced Culvert and Storm Drain Pipe

Manufactured in accordance with and conforming to ASTM C76M ASTM C76, Class II or V.

2.1.2 Poly Vinyl Chloride (PVC) Pipe

2.1.2.1 Type PSM PVC Pipe

ASTM D3034, maximum SDR 35.

2.1.2.2 Profile PVC Pipe

ASTM F794, Series 46. 2.1.2.3 Smooth

Wall PVC Pipe

ASTM F679. 2.1.2.4 Corrugated PVC

Pipe

ASTM F949.

2.1.3 Polyethylene (PE) Pipe

2.1.3.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Polyethylene compound material designation PE3608.

2.1.3.2 Corrugated PE Pipe

AASHTO M 294, Type S. Provide pipe walls having the following properties:

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
12	1.5	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.3.3 Profile Wall PE Pipe

ASTM F894, RSC 160. Provide pipe walls having the following properties:

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment (in to the 4th/in)	
		Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	7.81	0.202	0.165
42	8.08	0.277	0.227
48	8.82	0.338	0.277

2.2 PIPE JOINTS

2.2.1 Concrete Pipe

2.2.1.1 Rubber Gasket Joints

Provide rubber gasket joints of a design and physical requirements conforming to ASTM C443.

2.2.1.2 Preformed Flexible Sealant Joints

Provide joints made with preformed flexible joint sealant conforming to ASTM C990.

2.2.2 PVC Plastic Pipe

Provide solvent cement or elastomeric gasket type joints in accordance with the specification for the pipe and as recommended by the pipe manufacturer. Use solvent cement conforming to ASTM D2564. Provide gaskets for elastomeric joints conforming to ASTM F477.

2.2.3 Smooth Wall PE Plastic Pipe

Join pipe using butt fusion method conforming to ASTM F2620. No offset in alignment between adjacent pipe ends is permitted.

2.2.4 Corrugated PE Plastic Pipe

Provide soil tight joints conforming to the requirements in AASHTO M 294.

2.2.5 Profile Wall PE Pipe

Provide gasketed or thermal weld type with integral bell joints in accordance with ASTM F894.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, provide concrete and reinforced concrete conforming to the requirements for 4000 psi concrete under Section 03 30 00 CAST-IN-PLACE CONCRETE. Provide air content by volume of concrete mixture, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Determine air content in accordance with ASTM C231/C231M.
Provide a minimum concrete covering over steel reinforcing of not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. For concrete deposited directly against the ground, provide a covering thickness of at least 3 inches between steel and ground. Provide expansion-joint filler material conforming to ASTM D1751, or ASTM D1752, or provide be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Mortar

Mortar is not allowed for pipe joints. Provide mortar for pipe connections to drainage structures conforming to ASTM C270, Type M, except that the maximum placement time will be 1 hour. Provide a sufficient quantity of water in the mixture to produce a stiff workable mortar but in no case may the quantity exceed 5 gallons of water per sack of cement. Use water that is clean and free of harmful acids, alkalis, and organic impurities. Use the mortar within 30 minutes after the ingredients are mixed with water.

2.3.3 Precast Reinforced Concrete Manholes

Provide precast reinforced concrete manholes conforming to ASTM C478/C478M . Provide joints between precast concrete risers and tops that are full-bedded in cement mortar and smoothed to a uniform surface on both interior and exterior of the structure.

2.3.4 Frame and Cover or Gratings

Provide frame and cover or gratings made of cast ductile iron, ASTM A536. Provide curb inlet grates conforming to the weight, shape, size, and waterway openings indicated on the plans. Stamp or cast the word "Storm Sewer" into covers so that it is plainly visible.

2.3.5 Flared End Sections

2.3.5.1 Concrete Flared End Sections

Provide sections of a standard design fabricated with reinforced concrete.

2.3.6 Downspout Boots

Use boots conforming to ASTM A48/A48M, Class 30B or 35B of the size and shape indicated for connecting exterior downspouts to the storm-drainage system.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavate trenches, excavate for appurtenances and backfill for culverts and storm drains, in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

Excavate trenches to the width indicated on the drawings or as specified herein. Trench width should permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Place sheeting and bracing, where required, within the trench width as specified, without any overexcavation.

3.1.2 Removal of Rock

Replace rock in either ledge or boulder formation with suitable materials to provide a compacted earth cushion. Provide a compacted earth cushion between unremoved rock and the pipe with a thickness of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Maintain the cushion under the bell as well as under the straight portion of the pipe where bell-and-spigot pipe is used. Excavate rock as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe or culvert, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, remove such material to the depth required and replace with select granular material to the proper grade. Compact select granular material as specified in paragraph FINAL BACKFILL. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, perform such removal and replacement at no additional cost to the Government.

3.2 BEDDING AND INITIAL BACKFILL

Provide a firm bedding foundation of uniform density throughout the entire length of the pipe or culvert.

3.2.1 Concrete Pipe

Use select granular material conforming to Section 31 00 00 EARTHWORK for haunch and bedding material. Compact haunch and outer bedding to at least 90 percent laboratory maximum density and place in layers not exceeding 6 inch loose thickness for compaction by hand-operated compactors and 8 inches for other than hand-operated machines. Loosely place middle bedding and do not compact. After the pipe has been properly bedded, place haunch material, at a moisture content that will facilitate compaction, evenly along both sides of the pipe and thoroughly compact each layer with mechanical tampers or rammers to the springline of the pipe. Thoroughly compact the haunch material under the haunches of the pipe. For bell and spigot pipe, form a depression in bedding material for bells so entire barrel of pipe is uniformly supported. Minimize the length, depth, and width of bell depressions to that required for properly making the particular type of joint.

3.2.1.1 Trenches

After the pipe has been properly bedded and haunch material placed to the midpoint (springline) of the pipe, backfill and compact the remainder of the trench by spreading and rolling or compacting by mechanical rammers or tampers in layers not exceeding 6 inches. Test for density as necessary to ensure conformance to the compaction requirements specified below. Leave untreated sheeting in place beneath structures or pavements.

3.2.1.2 Fill Sections

For pipe placed in fill sections, uniformly spread fill material longitudinally on both sides of the pipe in layers not exceeding 6 inches in compacted depth, and compact by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe must extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, place and thoroughly compact the remainder of the fill in layers not exceeding 8 inches.

3.2.2 Plastic Pipe

Provide bedding for PVC and PE pipe meeting the requirements of ASTM D2321. Use Class IB or II material for PVC, PE pipe bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.3 PLACING PIPE

Submit printed copies of the pipe manufacturer's recommended pipe installation procedures prior to installation. Thoroughly examine each section of pipe before being laid; do not use defective or damaged pipe. Protect plastic pipe from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Lay pipelines to the grades and alignment indicated. Provide proper facilities for lowering sections of pipe into trenches. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work. Divert drainage or dewater trenches during construction as necessary. Deflection of installed flexible pipe must not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (percent)
Plastic (PVC and HDPE)	5

3.3.1 Concrete, PVC, Ribbed PVC

Lay pipe proceeding upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 PE Pipe

Lay on a bed shaped to line and grade and joint sections together in accordance with manufacturer's guidelines.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe must be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe and Culverts

Follow the recommendation of the particular manufacturer in regard to sealing compound special installation requirements. When lubricants, primers, or adhesives are used, only apply on surfaces that are dry and clean. Affix sealing compounds to the pipe or culvert not more than 3 hours prior to installation of the pipe or culvert. Protect sealing compounds from the sun, blowing dust, and other deleterious agents at all times. Inspect sealing compounds before installation of the pipe or culvert, and remove and replace any loose or improperly affixed sealing compound. Align the pipe or culvert with the previously installed pipe or culvert, and pull the joint together.

3.4.1.2 Flexible Watertight Joints

Use lubricants, cements, adhesives, and other special installation requirements for gaskets and jointing materials as recommended by the manufacturer. When lubricants, cements, or adhesives are used, only apply on surfaces that are clean and dry. Affix gaskets and jointing materials to the pipe not more than 24 hours prior to the installation of the pipe, and protect from the sun, blowing dust, and other deleterious agents at all times. Inspect gaskets and jointing materials before installing the pipe; remove and replace any loose or improperly affixed gaskets and jointing materials. Align the pipe with the previously installed pipe, and push the joint home. If the gasket becomes visibly dislocated when joining sections of pipe, remove the pipe and remake the joint.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construct manholes of precast reinforced concrete. Construct inlets of precast reinforced concrete. Provide manholes and inlets complete with frames and covers or gratings

3.5.2 Walls and Headwalls

Construct walls and headwalls as indicated.

3.6 INSTALLATION OF TRACER WIRE AND WARNING TAPE

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe in accordance with Section 31 00 00 EARTHWORK. Attach wire to top of pipe in such a manner that it will not be displaced during construction operations. Install warning tape above all storm drain pipe in accordance with Section 31 00 00 EARTHWORK.

3.7 FINAL BACKFILL

Backfill trenches with satisfactory material deposited in layers of a maximum of 8 inches loose thickness and compacted to 90 percent of maximum density for cohesive soils and 95 percent of maximum density for cohesionless soils in accordance with Section 31 00 00 EARTHWORK. Testing is the responsibility of the Contractor and will be performed at no additional cost to the Government. Unless otherwise specified, determine field in-place density of final backfill at a frequency of one test per 50 linear feet, or fraction thereof, of

each lift of backfill. Submit test results in accordance with Section 31 00 00 EARTHWORK. Do not displace or damage pipe when compacting final backfill by rolling or operating heavy equipment parallel with the pipe. Movement of construction machinery over a culvert or storm drain at any stage of construction will be at the Contractor's risk. Repair or replace any damaged pipe. Protect concrete pipes with a minimum of 3 feet of cover prior to permitting heavy construction equipment to pass over them during construction. Provide the minimum cover for construction loads over corrugated steel pipes as specified in Section 26, Division II of AASHTO HB-17. Provide minimum cover for construction loads over plastic pipes as specified in ASTM D2321.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.8.1.1 Deflection Testing

Conduct deflection test no sooner than 30 days after completion of final backfill and compaction testing. Clean or flush all lines prior to testing. Perform a deflection test on entire length of installed flexible pipeline upon completion of work adjacent to and over the pipeline, including backfilling, placement of fill, grading, paving, placement of concrete, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads must not exceed the limits in paragraph PLACING PIPE AND CULVERT above as percent of the average inside diameter of pipe. Use a mandrel to determine if allowable deflection has been exceeded.

3.8.1.1.1 Mandrel

Pass the mandrel through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, stop and begin test from the opposite direction. The mandrel must meet the pipe manufacturer's recommendations and the following requirements. Provide a mandrel that is rigid, nonadjustable, has a minimum of 9 fins, pulling rings at each end, and is engraved with the nominal pipe size and mandrel outside diameter.

The mandrel must be 5 percent less that the certified-actual pipe diameter for plastic pipe, 5 percent less than the certified-actual pipe diameter for corrugated steel and aluminum, 3 percent less than the certified-actual pipe diameter for ductile iron culvert pipe. The Government will verify the outside diameter (OD) of the Contractor provided mandrel through the use of Contractor provided proving rings.

3.8.1.2 Tracer Wire Continuity

Test tracer wire for continuity after initial and final backfilling of pipes. Verify that tracer wire is locatable with electronic utility location equipment. Repair breaks or separations and re-test for continuity.

3.8.2 Repair of Defects

3.8.2.1 Deflection Testing

When deflection readings are in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection and replace with new pipe. Retest 30 days after completing backfill, leakage testing and compaction testing.

3.9 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.10 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

-- End of Section --

APPENDIX A

Proposed Headhouse and Greenhouse

Geotechnical Engineering Report

National Center for Agricultural Utilization Research

April 16, 2025 | Terracon Project No. KE235291

Prepared for:

Bailey Edward Design
1103 South Mattis Ave,
Champaign, IL, 61821-4829

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April 16, 2025

Bailey Edward Design
1103 South Mattis Ave,
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Attn: Mr. Michael L. Petti
P: 312.789.4009
E: mpetti@baileyedward.com

Re: Geotechnical Engineering Report
Proposed Headhouse and Greenhouse
National Center for Agricultural Utilization Research
1815 North University Street
Peoria, Illinois
Terracon Project No. KE235291

Dear Mr. Petti:

We have completed the scope of Geotechnical Engineering services for the referenced project in general accordance with Terracon Proposal No. PKE235291 dated August 29, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon
(Illinois Firm Registration No. 184004050-0006)

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Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Headhouse and Greenhouse at the National Center for Agricultural Utilization Research to be located at 1815 North University Street in Peoria, Illinois. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site/subgrade preparation and earthwork
- Foundation design and construction
- Floor slab design and construction
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings of the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning.

Item	Description
Information Provided	An email request for proposal was provided by Ms. Joi Ford of Edward Bailey on August 29, 2023. The request included a plan layout of the proposed development.

Item	Description
Project Description	We understand the project includes construction of a new headhouse building with a maximum plan area of 800 square feet and a new greenhouse building with a maximum plan area of 3000 square feet consisting of 4 bays. The construction also includes new sidewalks around the greenhouse and headhouse, and a new corridor from main building to the new headhouse.
Building Construction	We anticipate the proposed steel framed structure with slab-on-grade floor slab and supported on spread and continuous footings.
Finished Floor Elevation	The planned FFE for the proposed headhouse and greenhouse building was not provided. Based on current site grades, we anticipate that the new building's FFE will be within one to two feet of the current ground surface elevations.
Maximum Loads	Anticipated structural loads were not provided hence following loads are assumed: ▪ Column load: 50 kips ▪ Exterior wall load: 3 kips per linear foot (klf) ▪ Slabs: less than 150 psf
Grading	Less than 2 feet of cut and/or fill is anticipated to develop final grades across the site.
Below-Grade Structures	Below-grade structures or retaining walls are not anticipated.
Pavements	Based on the provided diagrams from Bailey Edward, new pavements are not planned for the proposed project.

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The proposed project is located at 1815 North University Street in Peoria, Illinois. Approximate Latitude (approximate) 40.7086° N Longitude 89.6139° W (See **Site Location**)
Existing Improvements	Based on historical photos, portions of the project site might have been used as a garden plot. Other existing improvements include: ▪ Existing 3 story building to the north of the project site ▪ Existing greenhouse to the west of the project site
Current Ground Cover	Grass lawn, trees, and concrete sidewalks
Existing Topography	The site appears to slope down to the south from about elevation 592 to 589 feet.

Geotechnical Characterization

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results**.

Model Layer	Layer Name	General Description
1	**Topsoil**	Approx. 6 to 8 inches of topsoil
2	**Lean Clay**	Generally stiff to very stiff consistency Near surface samples had low water contents and might be desiccated
3	**Lower Strength Lean Clay**	Generally medium stiff
4	**Sand/Silt**	Generally loose to medium dense

Groundwater Conditions

The borings were advanced using hollow stem augers allowing for short-term groundwater observations to be made while drilling. The boreholes were observed while drilling and shortly after completion of drilling for the presence and level of groundwater, and groundwater was not encountered in the soil borings.

The water levels observed in the borings do not necessarily correspond to stable groundwater levels. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels, and subsurface water conditions may be different at the time of construction and over the life of the structure. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project.

Geotechnical Overview

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Based on the conditions encountered in several borings (e.g., B-3, B-4, P-1, and P-3), several near surface soils were relatively dry (desiccated). Dry or desiccated clay soils have potential for expanding (swell) as moisture contents increase. Moisture conditioning and recompacting the near-surface clay soils will be important. The risk of future subgrade volume change (either shrinking or swelling) cannot be completely eliminated. Even low plasticity clay soils shrink and swell to some extent with normal seasonal variations in moisture content, some minor movements normally occur and

should be expected. Silt was encountered in Boring B-1 from the ground surface to a depth of approximately 5.5 feet. This material is typically fine-grained and may exhibit low shear strength and poor drainage characteristics. Given its composition, the silt could be sensitive to construction activities, particularly under changing moisture conditions or loading, which may lead to excessive deformation or instability. Appropriate precautions should be considered during construction to mitigate potential issues related to this layer. The recommendations in this report are intended to reduce the potential for movements and the resulting damage caused by volume changes in clay soils. Floor slab subgrade preparation should accommodate the placement of at least 1 foot of new structural fill.

We recommend foundation excavations extend through unsuitable soils (e.g. desiccated soils, existing fill, organic materials, low strength clay soils) to encounter suitable native soils. The foundations could bear on stiff to very stiff native soils at the lower level or the excavations could be backfilled with structural fill or lean concrete. Overexcavations should also be performed beneath thickened floor slabs that will support load bearing walls. A discussion of foundation support is included in **Shallow Foundations**.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and structural fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and floor slabs.

Site Preparation

Site preparation should commence with removal of any existing pavements, vegetation, topsoil, and root mats. To the extent practical, existing utilities should be rerouted around the area of new construction.

Portions of the project site might have been used as a garden plot and thicker layers of organic materials or disturbed soils should be anticipated. Additionally, some near-surface samples from the borings were relatively dry. Although not encountered in the borings, existing fill could be encountered during construction. If encountered, unsuitable materials (e.g., desiccated soils, existing fill, organic materials, low strength clay soils) should be removed from areas below and within at least 10 feet of new structures and replaced with structural fill. Overexcavations of unsuitable materials to designated depths below foundations and floor slabs could be performed during the site preparation. Floor slab subgrade preparation should accommodate the placement of at least 1 foot of new structural fill. If desiccated (dry) clay soils are encountered to

greater depths, deeper undercutting, moisture conditioning, and compaction may be required.

Once initial stripping and cutting has been completed and prior to placement of fill in areas below design grade and after completion of rough grading in cut areas of the site, the upper 8 inches of the subgrade should be scarified, moisture conditioned, and compacted to the density and moisture content ranges recommended in the **Fill Placement and Compaction Requirements** section.

The prepared soils should then be proofrolled with a fully loaded tandem axle dump truck with a gross weight of at least 25 tons or similarly loaded equipment. The proofrolling should be performed under the observation of the Geotechnical Engineer. Areas that rut or excessively deflect under the proofrolling should be improved by scarifying and compaction or by removal and replacement with an approved structural fill as discussed in **Fill Material Types**. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

Unstable areas identified during scarification and compaction should either be stabilized or undercut as recommended in the **Soil Stabilization** section of this report.

Tree removal and root removal are critical steps in site preparation as they significantly influence soil stability and construction conditions. Trees and their roots can alter the composition and behavior of the soil, potentially leading to issues such as uneven settlement, erosion, and moisture fluctuations that may affect foundation performance. Roots can infiltrate subsurface utilities and structures, creating voids or weak zones that compromise the integrity of the site. Additionally, the decomposition of tree roots can lead to soil instability over time, resulting in subsidence. Removing trees and roots reduces the risk of future soil movement, enables more accurate soil testing, and promotes a more reliable foundation design. This process also facilitates the removal of organic material that can interfere with soil compaction and drainage.

Soil Stabilization

Based on the outcome of the site preparation operations and season of construction, some subgrade stabilization should be expected for the site, especially if construction occurs during wet periods of the year.

If unsuitable areas are observed, subgrade improvement will be necessary to establish a suitable subgrade support condition. Terracon should be retained to discuss stabilization options. Potential methods of subgrade improvement are described below. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs.

- **Scarification and Compaction –** It may be feasible to scarify, moisture condition (i.e., dry or moisten), and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and favorable weather, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1½ feet.

- **Undercut and Replacement with Crushed Stone/Aggregate –** The use of crushed stone, crushed concrete, and/or gravel could be considered to improve subgrade stability. To limit depths of undercuts, the use of a geogrid could be considered after underground work, such as utility construction, is completed. The manufacturer's specifications for each reinforcement product should be verified prior to material purchase/delivery and placement at this site.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures or constructed slopes. General fill is material used to achieve grade outside of these areas.

Reuse of On-Site Soil: Excavated on-site soil that satisfy the recommendations in this report may be selectively reused as fill below floor slab, and landscaping areas. Moisture conditioning (e.g., wetting or drying) will be necessary to achieve compaction requirements if fine-grained materials are used as structural fill for the project.

Material property requirements for on-site soil for use as general fill and structural fill are noted in the table below:

Property	General Fill	Structural Fill
Composition	Free of deleterious material	Free of deleterious material
Maximum particle size	6 inches (or 2/3 of the lift thickness)	3 inches
Plasticity	Not limited	Liquid Limit less than 45 Plasticity Index less than 23
GeoModel Layer Expected to be Suitable[1]	2, 3, & 4	2, 3, & 4

Property	General Fill	Structural Fill

1. GeoModel Layer suitability is based on subsurface exploration. Actual material suitability should be determined in the field at time of construction. Specific material requirements will need to be satisfied based on intended use.

Imported Fill Materials: Imported fill materials should meet the following material property requirements.

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Low Plasticity Cohesive [2]	CL, CL-ML	▪ Site mass grading fill ▪ Below aggregate base for grade-supported slabs
Granular [3]	GW, GP, GM, GC, SW, SP, SM, SC	▪ Below grade-supported slabs ▪ Below foundations in overexcavations
Unsuitable	CL/CH, CH, MH, OL, OH, PT, ML	N/A

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel on the site.
2. By our definition, low plasticity materials should have a liquid limit of 45 or less and a plasticity index of 23 or less (ASTM D4318). Import of moderate to high plasticity fine-grained soil is not recommended. Fine grained materials (e.g., clays) can be difficult to compact in relatively small areas (e.g., excavations for foundations and utilities), and we recommend fine-grained materials are only used where placed with proper equipment during mass grading.
3. Specific material requirements will need to be satisfied based on intended use.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
Minimum Compaction Requirements [1,2,3]	95% of the maximum dry density	90% of maximum dry density
Water Content Range [1]	Low Plasticity Cohesive: -2% to +3% of optimum moisture content at the time of placement and compaction Granular: As required to achieve minimum compaction requirements.	As required to achieve minimum compaction requirements

1. Maximum density and optimum water content as determined by the Modified Proctor test (ASTM D1557).
2. Moisture levels should be maintained to achieve compaction without bulking during placement or pumping when proofrolled.
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

Grading and Drainage

All grades must provide effective/positive drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 5 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After

building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Planting trees, large shrubs, or other vegetation adjacent to structures supported on shallow foundations and/or with grade-supported slabs is not recommended. Trees and large shrubs can develop extensive root systems that can draw moisture from the subgrade soils, causing them to shrink during dry periods of the year. Drying or desiccation of clay soils below shallow foundations and grade-supported floor slabs can result in settlement of the foundations and slabs.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

If water seepage is encountered or if surface water collects in open excavations, the contractor should be prepared to remove water from the excavations. Water should not be allowed to accumulate in the bottom of the excavations. Water seepage that may occur can likely be managed by sump pits and pumps.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under **no** circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our Scope of Services does not include review of available final grading information or consider potential temporary grading performed by the Contractor for potential effects such as ground movement beyond the project

limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer. Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas identified during construction.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer or their representative. If unanticipated conditions are observed, the Geotechnical Engineer should recommend mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork** section, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	2,500 psf
Required Bearing Stratum [3]	■ Stiff to very stiff consistency native clays ■ New structural fill or lean concrete extending to suitable native soils

Item	Description
Minimum Foundation Dimensions	■ Isolated spread footings: 30 inches ■ Continuous footings: 18 inches
Minimum Embedment below Finished Grade [4]	■ Exterior footings: 3½ feet ■ Interior footings in heated areas: 1½ feet
Estimated Total Settlement from Structural Loads [2]	1 inch or less
Estimated Differential Settlement [2, 5]	3/4 or less of the total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or unstable soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Embedment necessary to reduce the effects of frost and/or seasonal water content variations. For perimeter footings and footings beneath unheated areas, the minimum footing embedment for frost protection should be 3½ feet. The minimum footing embedment for "interior footings" applies to footings that will not be subject to freezing weather and large moisture fluctuations during or after construction.
5. Foundation settlements will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of structural fill, and the quality of the earthwork operations and footings construction. Frequent control joints in the structure and sufficiently flexible connections are recommended help to accommodate differential settlement across the length of the structures.

Construction Adjacent to Existing Building

Differential settlement between the proposed corridor and the existing building is expected to approach the magnitude of the total settlement of the addition. Underground piping between the two structures should be designed with flexible

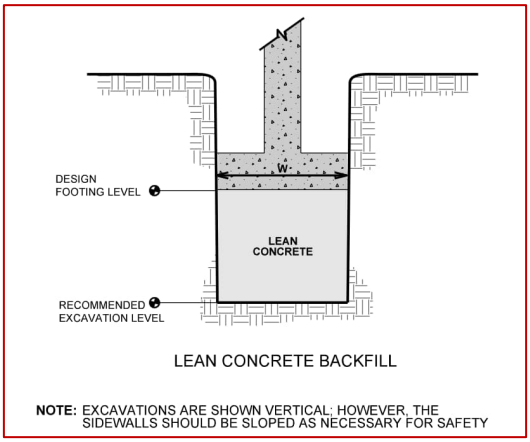
couplings and utility knockouts in foundation walls should be oversized so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations to avoid disturbing existing foundation bearing soils.

New foundations should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending on their locations and current loads on the existing footings, footings for the addition could cause settlement of adjacent existing walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the proposed addition's foundations and footings supporting the existing building.

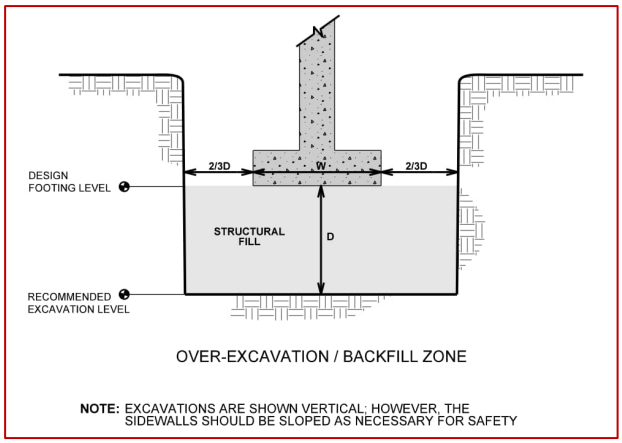
Shallow Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

An overexcavation procedure should be implemented where existing fill is encountered or where native clay soils exhibit estimated unconfined compressive strengths of less than 2,500 psf within 2 feet of the design footing level. If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation could be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. Alternatively, the contractor could use an overexcavation and backfill method to develop foundation support above new granular structural fill. The lean concrete replacement zone is illustrated on the sketch below. If lean concrete backfill (minimum 28-day compressive strength of 1,000 psi) is used and suitable soils are encountered at the base of the overexcavation, widening of the footing excavation may not be needed.



Overexcavations for granular structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation, with IDOT CA-6 material (or similar approved materials), compacted as recommended in the **Earthwork** section.



Floor Slabs

Design parameters for floor slabs in interior, conditioned building areas assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Per ACI requirements, minimum 4 inches of free-draining granular material with less than 3 percent fines (such as IDOT CA-7 or CA-11) Provide at least 1 foot of new low plasticity structural fill below floor slabs (the 4-inch free-draining granular layer is considered to be part of the recommended 1½ foot low plasticity material zone) Subgrade soils and aggregate base prepared according to the **Earthwork** section

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing, or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located. All floor slab subgrade areas should be moisture conditioned and compacted to the recommendations in **Earthwork** immediately prior to placement of the aggregate base materials and concrete.

Care will be necessary to avoid contaminating the floor slab granular base with soil prior to floor slab placement. We recommend the floor slab granular base be placed only immediately prior to slab concrete placement.

Frost Considerations

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade and sidewalks. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be reduced in critical areas, we recommend the use of low-frost susceptible (LFS) fill or structural slabs (for instance, structural stoops in front of building doors). Low-frost susceptible materials should consist of a well-graded, clean granular material with less than 6% passing the No. 200 sieve. Placement of LFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site drainage system.
- Install drains around the perimeter of the building, stoops and below exterior slabs, and connect them to the site drainage system.
- Grade clayey subgrades so groundwater potentially perched in overlying fill or aggregate base, slope toward a site drainage system.
- Place LFS fill as backfill beneath slabs critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between LFS fill and other soils.
- Place LFS materials in critical sidewalk areas.

As an alternative to extending LFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of LFS material.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration.

Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

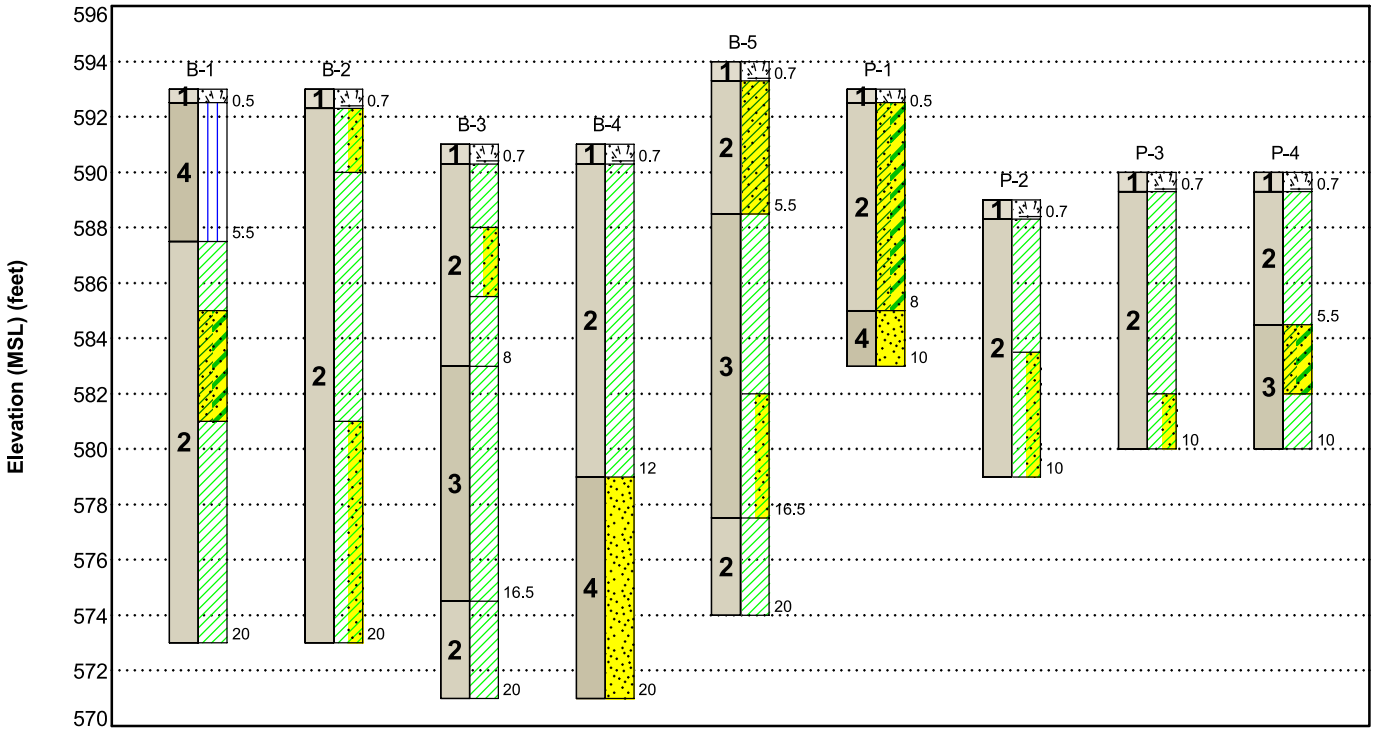
Figures

Contents:

GeoModel

Terracon
1145 N Main St
Lombard, IL

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Topsoil**	Approx. 6 to 8 inches of topsoil
2	**Lean Clay**	Generally stiff to very stiff consistency Near surface samples had low water contents and might be desiccated
3	**Lower Strength Lean Clay**	Generally medium stiff
4	**Sand/Silt**	Generally Loose to Medium Dense

LEGEND

- Topsoil
- Silt
- Lean Clay
- Sandy Lean Clay/Clayey Sand
- Lean Clay with Sand
- Poorly-graded Sand
- Sandy Lean Clay

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Borings	Boring Termination Depth (feet) [1]	Location
B-1 to B-4	20	Within footprint of proposed headhouse and greenhouse buildings
P-1 to P-4	10	Within footprint of proposed new corridor and sidewalks
B-5	20	Within the footprint of proposed new corridor

1. The drilled boring locations are shown on the attached **Exploration Plan**.

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with limited horizontal and vertical accuray. The ground surface elevations indicated on the logs are approximate and obtained from GPS. The boring locations were laid out using a best-fit overlay of the proposed site diagram on an aerial photograph.

The locations and elevations of the borings are considered accurate only to the degree implied by the means and methods used to define them. If more precise elevations and boring layout are desired, we recommend using a professional surveyor.

Subsurface Exploration Procedures: The borings were advanced with a truck-mounted drill rig using continuous hollow stem augers. Soil sampling was performed using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our laboratory for testing, and classified by a geologist.

Our field geologist prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing. Final boring logs were prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed field data and assigned laboratory tests to understand the engineering properties of various soil strata. the following laboratory testing were performed:

- Water content
- Atterberg limits
- Particle size analysis

Based on the results of our field and laboratory programs, we described and classified soil samples in accordance with the Unified Soil Classification System (USCS).

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

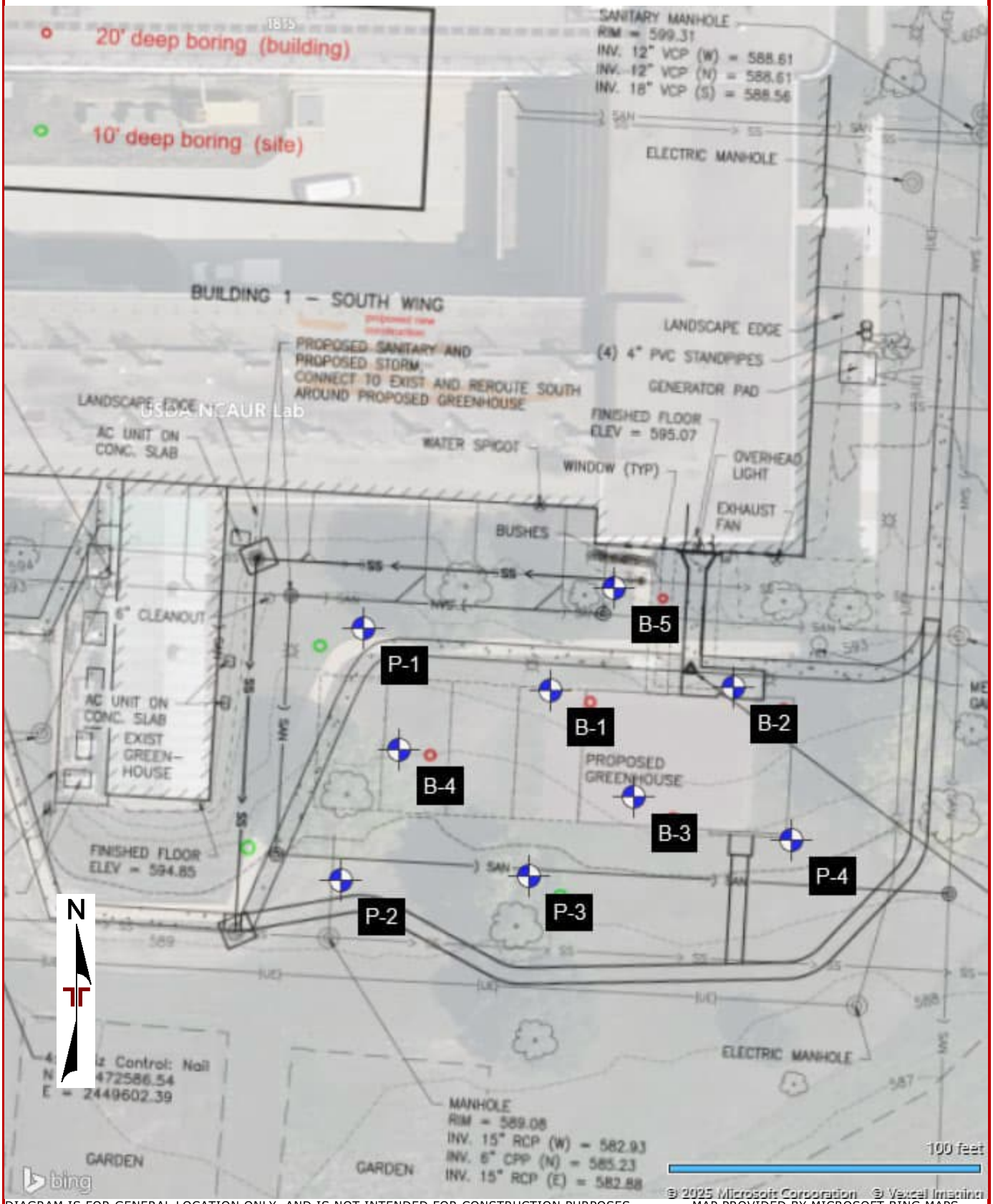


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-1 to B-5 and P-1 to P-4)
Particle size analysis

Note: All attachments are one page unless noted above.

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 40.7091° Longitude: -89.6141°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 593 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.5	**APPROX. 6 INCHES OF TOPSOIL** 592.5							
4			**SILT (ML)**, trace sand, brown, medium dense to loose			X	12	10-14-10 N=24	9.2	
						X	13	3-4-4 N=8	19.6	NP
		5.5	587.5	5						
2			**LEAN CLAY (CL)**, trace gravel, brown, stiff			X	17	3-3-5 N=8 2.5 (HP)	20.1	
		8.0	585							
			SANDY LEAN CLAY (CL), trace gravel, brown, stiff			X	16	3-3-3 N=6 1.5 (HP)	13.6	
		12.0	581	10						
			LEAN CLAY (CL), trace gravel, brown, very stiff			X	17	3-6-7 N=13 2.5 (HP)	14.2	
				15						
						X	17	3-7-12 N=19 4.2 B	13.5	
		20.0	573	20						
			Boring Terminated at 20 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes

Rimac test results presented in Field Test Results column in tsf

B=buldge failure of Rimac tested sample

S=shear failure of Rimac Test

HP=hand penetrometer test (tsf)

NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 40.7091° Longitude: -89.6139°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 593 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 592.3							
2		3.0	**LEAN CLAY WITH SAND (CL)**, trace gravel, brown, very stiff 590				13	5-5-4 N=9 2.5 (HP)	12.9	
		12.0	**LEAN CLAY (CL)**, trace gravel, brown, very stiff 581	5			16	4-4-4 N=8 2.5 (HP)	19.2	
							15	4-6-9 N=15 4.5 (HP)	17.7	
				10			15	3-5-7 N=12 4.5 (HP)	17.3	
		20.0	**LEAN CLAY WITH SAND (CL)**, trace gravel, brown, very stiff 573	15			18	3-6-9 N=15 4.0 (HP)	12.7	
				20			16	7-8-10 N=18 4.5 (HP)	12.0	
			Boring Terminated at 20 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
B=buldge failure of Rimac tested sample
S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 40.7090° Longitude: -89.6140°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 591 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 590.3							
2		3.0	**LEAN CLAY (CL)**, trace gravel, brown, very stiff 588			X	17	2-7-8 N=15 4.5 (HP)	11.8	
2		5.5	**LEAN CLAY WITH SAND (CL)**, trace gravel, gray, hard 585.5	5		X	16	3-7-10 N=17 4.5 (HP)	13.1	
2		8.0	**LEAN CLAY (CL)**, trace gravel, brown, very stiff 583			X	14	3-4-6 N=10 2.0 (HP)	17.9	
3		16.5	**LEAN CLAY (CL)**, trace gravel, gray to dark gray, medium stiff 574.5	10		X	10	1-2-3 N=5 1.0 (HP)	21.9	
				15		X	12	0-1-2 N=3 0.7 (HP)	23.4	
2		20.0	**LEAN CLAY (CL)**, trace gravel, brown, stiff 571	20		X	14	3-5-7 N=12 2.0 (HP)	15.0	
			Boring Terminated at 20 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
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S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 40.7091° Longitude: -89.6142°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 591 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 590.3							
2			**LEAN CLAY (CL)**, trace gravel, brown, very stiff to hard			X	16	4-8-8 N=16 4.5 (HP)	10.4	
						X	18	6-10-10 N=20 4.5 (HP)	10.9	
				5		X	15	7-11-14 N=25 4.5 (HP)	14.5	
						X	15	5-10-8 N=18 4.5 (HP)	7.3	
		12.0	579	10						
4			**SAND (SP)**, trace gravel, brown, loose			X	14	1-2-2 N=4 NP	5.1	
				15						
						X	13	3-4-4 N=8 NP	5.9	
		20.0	571	20						
			Boring Terminated at 20 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
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HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 40.7092° Longitude: -89.6140°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 594 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 593.3							
2		5.5	**SANDY LEAN CLAY (CL)**, trace gravel, brown, stiff to medium stiff 588.5			X	14	3-4-5 N=9 1.5 (HP)	14.7	
						X	17	2-2-4 N=6 0.5 (HP)	14.9	24-13-11
				5						
3		12.0	**LEAN CLAY (CL)**, trace gravel, brown, medium stiff 582			X	12	2-2-10 N=12 1.0 (HP)	24.5	
						X	16	2-3-4 N=7 1.0 (HP)	23.4	
				10						
		16.5	**LEAN CLAY WITH SAND (CL)**, trace gravel, gray, medium stiff 577.5			X	18	1-1-2 N=3 0.5 (HP)	25.1	
				15						
2		20.0	**LEAN CLAY (CL)**, trace gravel, brown, very stiff 574			X	6	5-9-9 N=18 3.5 (HP)	13.6	
				20						
			Boring Terminated at 20 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
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HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. P-1

Location: See Exploration Plan

Latitude: 40.7092° Longitude: -89.6143°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 593 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.5	**APPROX. 6 INCHES OF TOPSOIL** 592.5							
2			**SANDY LEAN CLAY (CL)**, trace gravel, brown, hard to stiff			X	18	6-7-9 N=16 4.5 (HP)	12.2	
						X	17	6-11-10 N=21 4.5 (HP)	9.9	
				5		X	15	4-4-4 N=8 1.0 (HP)	11.3	
		8.0	585							
4			**SAND (SP)**, trace gravel, brown, medium dense			X	14	5-5-5 N=10 NP	2.5	
		10.0	583	10						
			Boring Terminated at 10 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
B=buldge failure of Rimac tested sample
S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. P-2

Location: See Exploration Plan

Latitude: 40.7090° Longitude: -89.6143°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 589 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 588.3							
2		5.5	**LEAN CLAY (CL)**, trace gravel, brown, very stiff 583.5			X	14	6-8-15 N=23 2.0 (HP)	15.4	
						X	16	4-7-8 N=15 4.5 (HP)	14.3	
				5						
		10.0	**LEAN CLAY WITH SAND (CL)**, trace gravel, brown, very stiff 579			X	12	5-7-7 N=14 4.5 (HP)	11.0	
						X	17	4-6-12 N=18 2.5 (HP)	15.2	
			Boring Terminated at 10 Feet	10						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
B=buldge failure of Rimac tested sample
S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. P-3

Location: See Exploration Plan

Latitude: 40.7090° Longitude: -89.6141°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 590 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 589.3							
2			**LEAN CLAY (CL)**, trace gravel, brown to gray, stiff to very stiff			X	10	4-5-8 N=13 4.5 (HP)	12.5	
						X	14	7-12-12 N=24 4.5 (HP)	10.9	
				5		X	16	6-10-9 N=19 4.5 (HP)	10.9	
		8.0	582							
			LEAN CLAY WITH SAND (CL), trace gravel, brown, stiff to very stiff			X	15	4-5-6 N=11 3.0 (HP)	17.4	
		10.0	580	10						
			Boring Terminated at 10 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
B=buldge failure of Rimac tested sample
S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Boring Log No. P-4

Location: See Exploration Plan

Latitude: 40.7090° Longitude: -89.6138°

Model Layer	Graphic Log	Depth (Ft.)	Elevation.: 590 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**APPROX. 6 INCHES OF TOPSOIL** 589.3							
2		5.5	**LEAN CLAY (CL)**, trace gravel, brown, stiff to very stiff 584.5			X	9	2-4-6 N=10 2.5 (HP)	19.2	
				5		X	14	6-8-8 N=16 4.5 (HP)	14.8	
3		8.0	**SANDY LEAN CLAY (CL)**, trace gravel, brown, medium stiff 582			X	17	4-4-5 N=9 1.5 (HP)	13.5	
		10.0	**LEAN CLAY (CL)**, little gravel, brown, medium stiff to stiff 580	10		X	12	1-2-3 N=5 1.5 (HP)	15.5	
			Boring Terminated at 10 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
None observed

None observed

Drill Rig
CME750

Hammer Type
Automatic

Driller
Geocon

Logged by
Imelda Romero

Boring Started
02-20-2025

Boring Completed
02-20-2025

Notes
Rimac test results presented in Field Test Results column in tsf
B=buldge failure of Rimac tested sample
S=shear failure of Rimac Test
HP=hand penetrometer test (tsf)
NP=non-plastic

Advancement Method
"3.25" ID Hollow Stem Auger

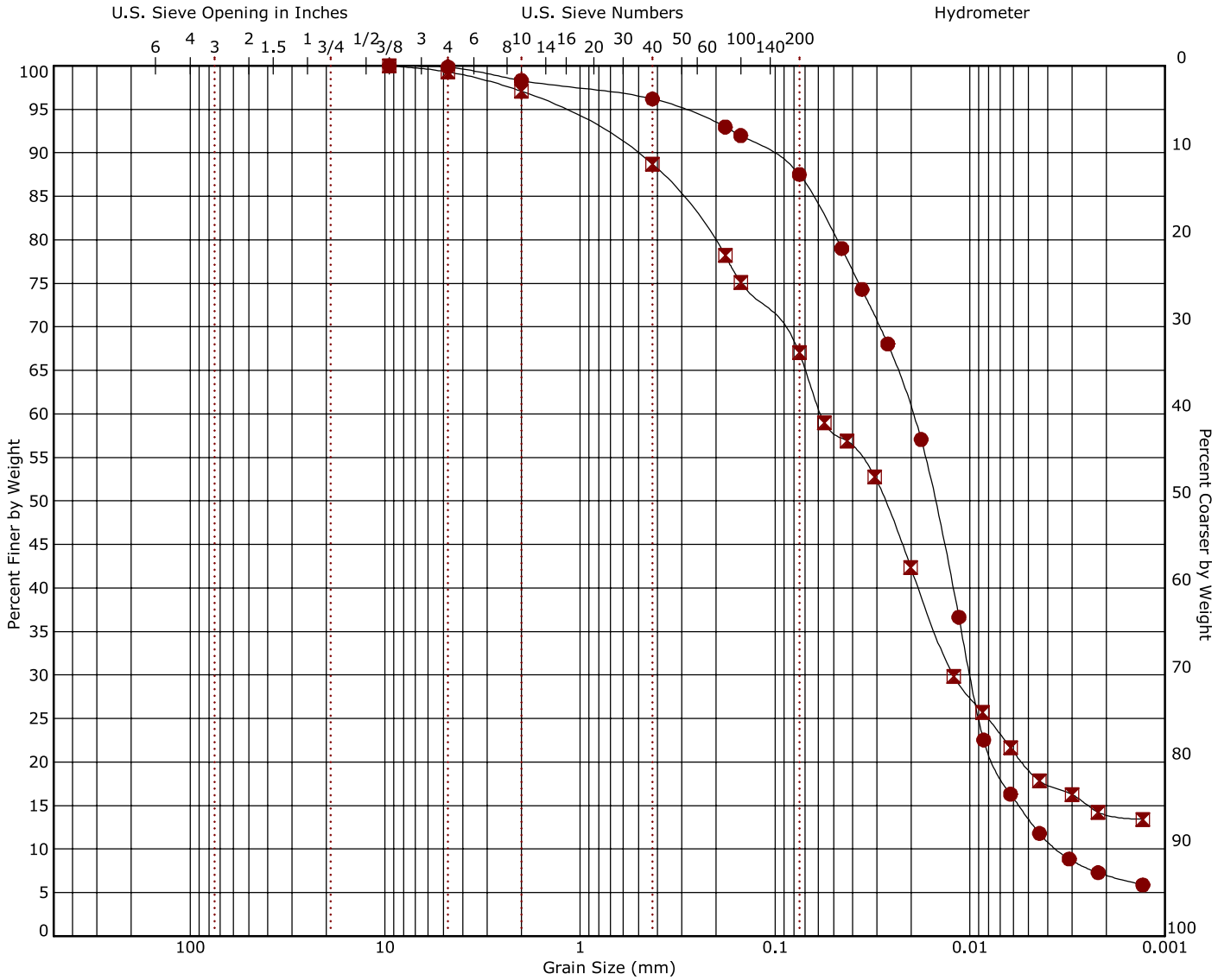
Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

New Headhouse and Greenhouse at NCAUR
1815 North University Street | Peoria, IL
Terracon Project No. KE235291

Terracon
1145 N Main St
Lombard, IL

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
●	B-1	3.5 - 5	SILT	ML	NP	NP	NP	1.40	5.57
⊠	B-5	3.5 - 5	SANDY LEAN CLAY	CL	24	13	11		

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-1	3.5 - 5	9.5	0.02	0.01	0.004	0.0	0.1	12.3		74.0	13.5
⊠	B-5	3.5 - 5	9.5	0.058	0.012		0.0	0.7	32.3		47.8	19.3

Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Calibrated hand penetromter
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(B)	Rimac bulge failure
(S)	Rimac shear failure
(NP)	Non-Plastic
(RDR)	Relative Drilling Resistance Criteria

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

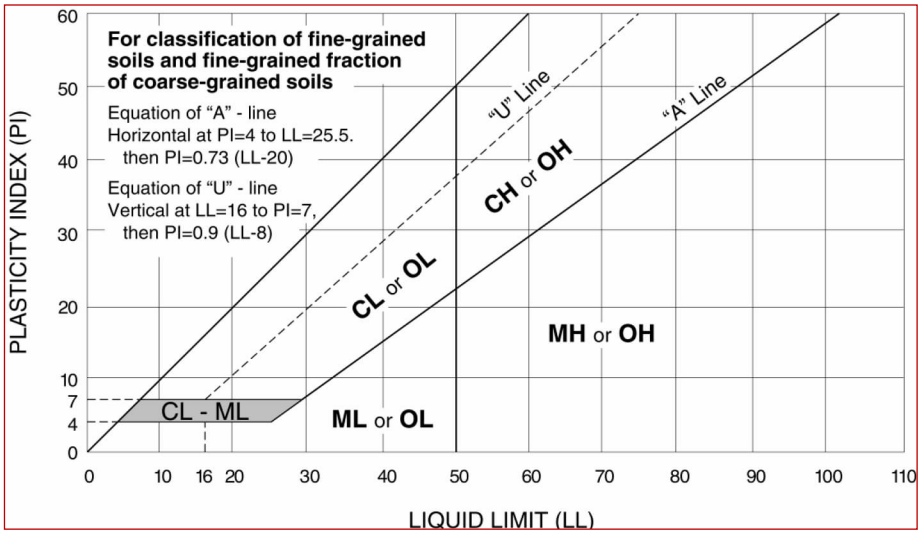
Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.