Minneapolis VA Medical Center

Project Number: 618-26-701

EHRM Infrastructure Upgrades- Minneapolis VAMC- MCR Modernization

Issued for Construction 100%

PROJECT SPECIFICATIONS

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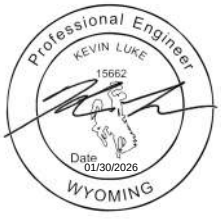

MINNEAPOLIS VA MEDICAL CENTER

EHRM INFRASTRUCTURE UPGRADES - MINNEAPOLIS VAMC - MCR MODERNIZATION

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SECTION 01 00 00
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SAFETY REQUIREMENTS

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

B. GENERAL INTENTION

C. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for EHRM Infrastructure Upgrades – MCR Modernization, VAMC, Minneapolis, MN as required by drawings and specifications.

D. Visits to the site by Bidders may be made in accordance with what is listed in the solicitation and at the discretion of the Contracting Officer.

E. Offices of Triple C – The A&E Group, 2508 29th Avenue NE, Minneapolis, MN, 55418 as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

F. The Key Personnel assigned by the contractor for the performance of work on this contract shall be acceptable to VA in terms of personal and professional conduct and technical knowledge. Should the assignment to this contract of any person by the contractor be deemed to conflict with the interests of VA, or in the event performance is deemed to be unsatisfactory at any time during the life of the contract, the Contracting Officer may notify the contractor and request the person be removed from the assignment. The reason for removal will be documented and a request to receive key personnel replacement within three (3) business days of the notification will be made. Replacement of key personnel qualifications shall be equal to or greater than those of the key personnel being replaced. Employment and staffing difficulties will not be justification for failure to meet established schedules. The contractor is required to submit a resume with qualifications for the proposed replacement which shall be approved by the COR and CO prior to the replacement starting work.

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

H. Prime Contractor Personal Minimum Requirements:
1. As Required in other parts of the Specifications and Contract Requirements the following are minimum requirements:
    a. The Superintendent shall be an employee of the Prime Contractor with authority to act as the contractor, responsible for the day-to-day operations at the construction site, planning, quality control, verification of delivery of approved material and equipment, subcontractor coordination responsibilities and execution of the complete project as per the contract documents.
        1) Superintendent shall have no hands-on construction interaction. In addition, the superintendent shall provide proof to the COR regarding completion of 30 hour OSHA.
        2) Superintendent assigned to this project shall not be assigned to any other project and shall only have duties on one project at a time.
        3) The Superintendent shall sign-in at the beginning of each day of work and Sign-out at the end of the work day at the Office of Engineering Service. No

work shall be performed by any contractors or subcontractors without the presence of the superintendent at the actual work site.

4) The Superintendent shall be responsible for submitting daily work logs to the COR at the end of every work day.

b. Site Safety and Health Officer (SSHO) shall be a separate qualified individual from the Prime Contractor's Superintendent or CQC System Manager with duties only as the SSHO. See 01 35 26 SAFETY REQUIREMENTS for more information on roles and responsibilities for General Contractor's staff.

c. CQC System Manager shall be a separate qualified individual from the Prime Contractor's Superintendent or Site Safety and Health Officer (SSHO) with duties only as the CQC System Manager. See Section 01 45 00 Quality Control for more information on roles and responsibilities for CQC Personnel.

d. The Prime contractor shall provide services of a Project Manager whose responsibilities would include but not be limited to providing support to the Superintendent at the job site and shall be responsible for finance related tasks and scheduling.

I. Electrical Work Permit

1. The contractor shall complete the VA Electrical Work Permit with the COR and submit to the COR. For Electrical work that requires an outage, outage requests must be submitted no less than 30 calendar days prior to requested date and time of work. Outages are at the convenience of the Minneapolis VAMC and may be canceled and/or rescheduled at any time prior to the approved outage date. No energized work is allowed, all electrical work must be done in a non-energized circuit and abide by OSHA, Facility and Contractor LOTO procedures.

J. Welding and Cutting

1. A Hot Work Permit is required. See Section 01 35 26, SAFETY REQUIREMENTS for requirements.

K. Contract Work Hours.

1. For all scope on this project, Contractor shall be required to work off duty hours to not impact continued operations of the Medical Center. Work shall be coordinated with and approved by the COR.

L. Contractor shall adhere to all requirements documented in the "Infrastructure Standard for Telecommunications Spaces, Version 4.0", "OEHRM Site Infrastructure and Und User Device (EUD) Requirements, Version 2.0" and the "VA Physical Security and Resiliency Design Manual, 2024". Deviation from VA standards is not allowable.

M. Contractor shall execute electrical, communications and security systems installations in accordance with TIA, VA and BICSI installation standards. The telecommunications contractor shall be a BICSI licensed Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International (BICSI). The RCDD licensed staff member shall be on-site throughout the life of the project to oversee all telecommunications and security

scope and shall provide consistent oversight of the project cabling throughout design, layout, installation, termination, and testing.

N. All testing shall be by certified testing laboratories subcontracted by the Contract. The Government shall not be required to contract testing for any trade.

O. All employees of general contractor and subcontractors shall comply with VA IT security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access. All employees of general contractor and subcontractors shall have successfully passed VA IT background checks or be escorted to work on Government networks. VA Engineering IT staff are not available to continuously escort and monitor Contractor activities.

P. The Government does not provide courtesy, pre-inspections of area during the construction. The Contractor shall request progress inspections and communicate requests for inspections at least one week in advance.

Q. Comprehensive 3rd party inspections, testing and written reports for all Divisions (paid by the General Contractor). Contractor shall employ third party inspection consultants to perform all inspections required by this contract. The VA has no inspection capability. Any reference to VA inspections shall be by a third-party inspector qualified to perform the work. Credentials shall be supplied to the VA/AE as required by this contract. All inspections, testing, certifications, and permits are to be paid for by the General Contractor. The VA will not pay for or perform any required inspections. VA inspections are for VA use only, when performed, and do not reduce the inspection burden on the Contractor. Third party inspection services must be submitted for acceptance by the VA after award. Submission to include resumes of inspectors, with alternates, projected days on site, qualifications of inspectors showing similar projects, related portfolio, and description of communication protocol with Owner. Minimum qualifications for each Division's inspector are identified in 01 45 00 "Experience Matrix". Third-Party inspections are in addition to, and independent of, the General Contractor's primary Quality Control Manager and associated protocol for Government/AE Construction Period Services.

R. Contractor shall notify VA COR minimum (7) days in advance of each third-party inspection to allow coordination with VA personnel.

S. Contractor to provide secure "Submittal Exchange" site dedicated for this project for the duration of the contract and for no less than 180 days post-construction completion/acceptance. Contractor will provide VA access to the site. Contractor will keep this site current and will use it for all submittals, RFIs, change documents, Record Drawing, electronic file management, and communication logs for the duration of the contract and for no less than 180 days post-construction completion/acceptance.

T. Contractor's Daily Logs shall be submitted to the VA COR on a weekly basis.

U. Contractor shall provide Submittal Exchange or approved equal (substitutions must be submitted with Contractor Bid), for the duration of the contract. Contractor will provide the VA Owner account access to the site. Contractor will keep this site current and will use it for all submittals, RFIs, change documents, Record Drawing, electronic file management, and communication logs for the duration of the contract.

V. Contractor shall provide Infection Control Plan as required by Memorandum 111-40, Subj: VHA Directive 7715 Safety and Health During Construction dated September 5, 2024. Submit to COR for approval prior to the start of work.

W. Prior to commencing work, general contractor shall provide proof that an OSHA designated "competent person" (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present. CP will have authority letter.

X. The General Contractor's Superintendent assigned to this project shall not be assigned to any other project and shall only have duties on one project at a time. See 01 35 26 SAFETY REQUIREMENTS for more information on roles and responsibilities for General Contractor's

staff. The Superintendent shall be a separate qualified individual from the Prime Contractor's Quality Control Manager (QCM) or Site Safety and Health Officer (SSHO) with duties only as the Superintendent. SSHO shall be a separate qualified individual from the Prime Contractor's Superintendent or QCM with duties only as the SSHO. QCM shall be a separate qualified individual from the Prime Contractor's Superintendent or SSHO with duties only as the QCM.

Y. Refer to specifications for installation requirements for each Division. Refer to drawings for estimated quantities and schematic layouts/locations. Contractor to provide a complete, commissioned, functioning product. The VA is not required to inspect or install any portion of this project. Contractor bears all installation and testing costs. Contractor to provide all testing reports prior to the start of commissioning. This project requires phased commissioning and turnover. This project will require night and weekend work during utility changeover; however, all cable replacements will occur during normal business hours, using the phasing plans developed by the Contractor to maintain continuous network service.

Z. Per VA Directive 1085, smoking, vaping and smokeless tobacco are prohibited on the grounds of VA facilities, including in vehicles. This Directive applies to all Prime Contractor and Subcontractor employees.

AA. Pricing Proposal transparency requirements:
1. This project requires pricing proposals to include breakdown pricing for the General Contractor and all subcontractors.
2. All price proposals shall include subcontractor pricing with a breakdown of pricing per the format included with this Project Manual. Third-party inspections must be included as a line item in the price proposal. See example at the end of Section 00 41 13 BID FORM.

1.2 STATEMENT OF BID ITEM(S)

A. Contractor shall completely prepare project site for operations, including demolition and removal of existing site elements, and furnish labor and materials and perform construction work for Project 618-26-701, EHRM Infrastructure Upgrades - Minneapolis VAMC - MCR Modernization as required by drawings and specifications. Period of performance is projected to be three-hundred and sixty-five days (365) calendar days.

B. Work includes general construction, alterations, and certain other items. Contractor shall provide services but not limited to furnish all supervision, labor, equipment, materials, and transportation necessary to accomplish work for the demolition and replacement as required by specifications and drawings.

C. Electrical, Telecommunications and Security Work: Electrical work includes all labor, material, equipment, and supervision to perform the required electrical construction work on this project including materials and construction equipment to modify the existing systems to provide new electrical, communications and security systems to the renovated space detailed by the construction drawings and specifications. Provide new telecommunications racks, patch panels, UPS, fiber panels and associated equipment. All CAT6A-CMP cable shall be tested to 10G ANSI performance, Fiber testing shall be via end-to-end power meter testing bi-directional format for all strands installed under this project scope.

D. All installed cables shall be terminated at each end with documentation, labeling, and test results provided. This applies to all permanently installed cable types. Building fiber will be plenum rated OM4 and OS2-10GB as shown on the drawings and specifications. All Copper replacement will be CAT 6A. CAT 6A Patch Cords shall be provided and installed for all locations, including patch cords.

E. Provide access control for all the required doors, coordinate with the door hardware schedule for additional requirements.

F. Mechanical, Plumbing and Fire Protection Work: Work includes all labor, material, equipment and supervision to perform the required Mechanical, Plumbing and Fire Protection construction work on this project including provide materials and construction equipment as detailed by the construction drawings and specifications.
   1. All new mechanical systems shall be compatible and integrated with the existing JCI system, New systems shall also be addressable and controllable via the existing Engineering Control Center (ECC) and HVAC Shop. The ECC system shall monitor space conditions and unit status and shall alarm the boiler plant operator or HVAC shop as detailed by the mechanical control drawings and specifications.
   2. Provide cabinet sensors and space temperature sensor, space humidity sensor, auxiliary drain pan moisture sensor (not float switch) and supply air temperature sensors on all CRAC units connect these to the central Engineering Control Center (ECC) system for trending and alarm purposes via BACNet with the manufacturer provided BACnet converter. Contractor shall submit coordination drawings prior to commencing work showing new and existing systems and all provisions for coordinating existing utilities.

G. New Fire Protection systems shall be provided, and existing systems modified per the construction drawings and specifications. Contractor shall reconfigure and/or provide additional sprinkler heads to the existing building automatic sprinkler system as shown on the drawings. For the Main Computer Room (MCR), the contractor is responsible for providing a new clean agent fire extinguisher cabinet with a Type 2A:10B:C fire extinguisher located no greater than 75 feet away from each entrance. Contractor to coordinate the new location with the COR. Contractor shall bid a new FECs in the Scope of Work. See specification 10 44 13.

H. A new Clean Agent Fire Suppression system shall be provided at the renovated MCR.

I. The data center space shall be provided with a dedicated zone and a new supervised valve.

J. Contractor shall reconfigure plumbing piping and provide new modify existing and provide new plumbing piping and fixtures as required by the construction drawings and specifications.

K. Inspections: Comprehensive Third-Party inspections, testing and written reports for all Divisions are required and paid by the General Contractor. Contractor shall employ third party inspection consultants to perform all inspections required by this contract.

L. All new and existing systems within the Scope of Work shall be commissioned (or recommissioned) per Specification 01 91 00.

M. Contractor shall appoint a third-party individual, company, or firm to act as the Commissioning Agent. The Commissioning Agent is the designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process

N. ITEM I, GENERAL CONSTRUCTION: BASE BID Work includes general construction, alterations, and necessary removal of existing structures and construction and certain other items. Contract documents, drawings, and specifications indicate the scope of work. This project provides the phased renovation of the Building 70 Data Center to support EHRM..
   1. New IT Equipment Enclosures: Provide new racks and cabinets. Revise the MCR layout to balance and support future consolidation of the facility computer room spaces.
   2. Provide new cold aisle containment.
      a. Basis of Design: Contain-IT FLEX Containment – CF Product Line.
   3. Provide redundant Rack Power Distribution Units.
   4. Provide new power distribution to the MCR and enclosures.
   5. Provide new cable management for the entire MCR.
   6. Provide structured cabling and management to comply with ISTS standards.
   7. Relocate and terminate existing Campus Fiber Backbone cabling in the renovated MCR.
   8. Provide New redundant MDAs for A/B paths to renovated MCR. Each Inside Plant (ISP) path less than 400m shall be 24F OM4/12F OS1 (each path and each TR). Each Outside (OSP) path or greater than 400m shall be OS2/12F OS1 (each path and each TR).

9. Revise Data Center layout per the construction drawings, with a phased renovation.
10. Provide underfloor raceway fed from UPS A and B.
11. Provide phasing plan to transfer critical power to the new redundant UPS. Provide all required temporary cooling and power to always maintain 2N redundancy.
12. Install UPS A and B. UPS equipment itself is already located in the room. The project will provide the phasing, installation and final room configuration.
13. Provide additional raised floor shoring/structural supports at UPS locations.
14. Provide new structural support for Novec gas fire suppression system and new Novec gas fire suppression system to serve the revised room configuration and new cold aisle containment.
15. Building 70 existing wet pipe fire suppression piping will be extended to serve the renovated space with a dedicated pre-action system.
16. Remove existing HVAC systems and provide temporary utilities to ensure no loss of cooling during construction.
17. Provide upflow CRAC units to serve ductwork in the interstitial space above.
18. Reconfigure ductwork to serve the new cabinet layout.
19. Complete new core drills. Install or relocate existing ductwork. Provide structural reinforcement at new interstitial slab penetrations. Remove unused legacy ductwork and fire seal abandoned penetrations.
20. Connect to existing IT chilled water loop per plans.
21. Replace existing suspended ceiling. Provide phasing plan for replacement.
22. Provide new gaseous fire suppression (Novec) system to be present both inside and exterior to the containment perimeter.
23. Provide cable tray and all structured cabling. Provide a complete cable tray ring (20" x 4” 6'-9' AFF) suspended from interstitial slab with all required fittings and accessories.
24. Provide and install pre-terminated structured cabling to interconnect MDAs, HDAs and Equipment Distributors.
25. Support relocation of equipment from BH-111 Telephone Equipment Room (TER) and BG-111 Biomedical Computer Room to 2B-105 renovated MCR. BH-111 contains legacy telephony distribution, entrance room functions and network core and campus fiber distribution. The MCR renovation will relocate entrance room, network core and campus fiber distribution to 2B-105 to be supported by 2N electrical, N+1 mechanical and 2N telecommunications.
26. Fiber shall be reconfigured and terminated in the new MDAs in the renovated MCR, 2B-105.
27. Provide double door access (wood doors to match existing with hollow metal frame) and room signage. Doors shall be coordinated with clean agent system requirements for the undercut.
28. Construct access floor ramp (access floor system ramp and handrails) to get from the corridor level up the access floor level.
29. Replace all raised floor tiles, modify the raised access floor to accommodate the new ramp and remove existing ramp to coordinate with new layout.
30. Paint all walls, doors and door frames. Patch vinyl wall covering at corridor. Modify the existing handrail at corridor to accommodate the new door. Patch sheet vinyl floor at corridor to match the existing floor. Since the existing flooring is no longer in stock and attic stock cannot be guaranteed, design provides a new flooring coordinated with existing.
31. All interior finishes are subject to final approval by Station Interior Designer. Relocate existing artwork as directed by the VA. Relocate/coordinate wayfinding signage suspended from the corridor ceiling to coordinate with the new door. Provide VCT or sheet vinyl flooring over concrete at ramp landing.
32. Provide new suspended ACT ceiling. The proposed system is purpose built for data center applications, basis of design: Armstrong Dynamax, or approved equal. https://www.armstrongceilings.com/commercial/en/suspension-systems/dynamax-structural-aluminium-data-center-grid.html

33. Provide new Air-cooled chiller, heat exchanger, and water/glycol mix and water pumps for the chilled water loop system. Working includes all necessary mechanical piping, insulation, supports, and connections required to fully integrate the new equipment into the existing chilled water loop.
34. Construction addresses deficiencies including new electrical service, new dedicated mechanical units, new electrical, new grounding and bonding conditions within the MCR, new racks and cable management equipment and new cable tray for each building as shown on the plans.
35. Provide new equipment rack(s) and associated components furnished with both horizontal and vertical cable managers, vertical bonding bars, patch panels and an optical fiber termination. All telecommunications equipment and cabling shall be tested, approved, and accepted by the VA prior to connecting to active, ongoing operations. Any modifications required to existing systems (HVAC, smoke detectors, fire alarm, fire sprinklers, lights, other devices, etc..) are the responsibility of the Contractor. The VA will not assist with any modification.
36. Provide new electrical panels, transformers, circuit breakers and distribution to serve the renovated MCR.
37. Provide Physical Security Access Control (PACS) for all the MCR doors (including controllers and power supplies), coordinate with the door hardware specification for additional requirements. The existing fire alarm system will be modified by replacing and adding compatible devices to the existing building fire alarm system**.**
38. Contractor shall provide a 30-day load test on all existing source panels serving new work at each Building. This test is required by NEC 220.87 for verification that no loads have been added since the design level survey. Contractor shall provide load monitoring data to the COR/AE. New electrical panels and electrical service branch circuits are specified by the scope of work and shall be furnished by the contractor. Load monitoring shall also be performed on all panels upstream of the new branch circuit panels.
39. Work includes all labor, material, equipment, and supervision to perform the required Mechanical, Plumbing and Fire Protection construction work on this project including new dedicated cooling, condensate pumps and drains, and reconfiguring and certifying existing wet pipe fire protection system and existing clean agent fire suppression system.
40. Contractor shall submit coordination drawings for approval showing all trades including: equipment locations, proposed routing, supports and penetrations prior to beginning any work. Also indicate new and existing systems and all provisions for coordinating existing utilities.
41. All new and existing systems within the Scope of Work shall be commissioned (or recommissioned) per Specification 01 91 00.
42. The contractor shall adhere to the following temporary fiber/phasing plan:
    a. Provide temporary fiber path (dual paths of 48F OM/24F OS14) will be provided from the existing Demarc, MCR and Cores to serve the renovated MCR concurrently until the new paths are commissioned.
    b. Redundant Single Mode Fiber will be provided between these locations to ensure connectivity.
    c. The contractor shall submit a phasing plan that ensures the renovated MCR includes a block of time for "**MCR Activation by VA" 3-6 months depending on size. WAO Activation of NEW TR cannot be completed until at least one side of fiber is connected and both COREs are connected to TR**.
    d. MCR rack relocations will have intermitted timeframes of "MCR Activation by VA" where GC cannot work.
    e. Redundant temporary fiber 48F SM will be provided from the existing cores to the new MCR.
        1) Minimum 4 SM Pairs for each Core
        2) Minimum 4 SM Pairs for each Router.
        3) Minimum 2 SM Pairs for each for SM distribution to DEMARC as required.

O. Based on the approved schedule by the VA COR (and based on approved Project Schedule and Phasing plan submittals), required shutdowns shall be limited to one at a time to minimize the impact on Facility Operations.

P. The expected construction period of 365 Calendar days includes all pre-construction activity, construction, and post-construction testing, third-party inspections, Owner inspections, and commissioning. Contractor shall submit a comprehensive schedule of work in compliance with 01 32 16.15 PROJECT SCHEDULES (SMALL PROJECTS DESIGN/BID/BUILD).
1. Contractor shall submit and obtain approval for all project submittals including coordination drawings prior to beginning physical construction.
2. Contractor shall perform Commissioning of all new systems and existing systems impacted by the project according to requirements in sections:
   a. 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS.
   b. 21 08 00 – COMMISSIONING OF FIRE SUPPRESSION SYSTEMS.
   c. 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS.
   d. 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.
   e. 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS.
   f. 27 08 00 – COMMISSIONING OF COMMUNICATIONS SYSTEMS.
   g. 28 08 00 – COMMISSIONING OF SECURITY SYSTEMS.

Q. A detailed commissioning plan is required to ensure that all systems are calibrated, programmed, and all graphic displays are accurate and approved by applicable VA staff.

1.3 BRAND NAME REQUIREMENTS

A. Reference Memo J and A – Brand Name MCR Mod – Minneapolis
The use of the following brand name for the items listed below accommodates standardization of these items throughout the facility:
1. Security/CCTV
   a. Lenel – Materials
2. Spray Applied Fireproofing
   a. CAFCO Blaze Shield II
3. Interior Signage
   a. InPro Takeform Fusion
4. Fire Alarm Components
   a. Gamewell – Materials
5. Direct-Digital Control System for HVAC
   a. METASYS Software
   b. Johnson Controls Incorporated (JCI) – materials
   c. JCI - Contractor

1.4 BASIS OF DESIGN

A. The below list of equipment is identified as the Basis of Design for this project:
1. Cold Aisle Containment
   a. Legrand Contain-IT FLEX Containment – CF Product Line
2. CRAC Units
   a. Liebert CW114 with Centrifugal Blowers
3. Air Cooled Chiller
   a. Trane RTAF280
4. Vigilent Dynamic Cooling Management
   a. Vigilent Dynamic Cooling Management
5. Dry-Pipe Fire Suppression System
   a. HD Fire Protect Pre-Pack Double Interlock System with Electric Actuation

6. Terminal Units
   a. Titus - DESV
7. Motion Detection
   a. Bosch DS9370 Panoramic Tritech Detector
8. Access Flooring Tiles
   a. Tate
9. Ceiling Tiles
   a. Armstrong Dynamax, or approved equal.
10. Door Hardware
    a. Sargent-Assa-Abloy with Medco 4X Large Format 6 pin interchangeable cores.
11. Fire Alarm
    a. Firenet - Contractor

1.5 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

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

B. Refer to specifications for installation requirements for each Division. Refer to drawings for estimated quantities and schematic layouts/locations. Contractor shall provide a complete, commissioned, functioning systems. Contractor shall provide all testing reports prior to the start of commissioning. This project will require night and weekend work, Renovation includes requirements for Testing and Balancing the HVAC for the existing and new systems configuration.

1.6 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:
   1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
   2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:
   1. General Contractor’s employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
      a. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
   2. **Badge requests shall be initiated immediately after Notice of Award**. The timeline for badging is anticipated at 6-8 weeks from the submission of OF306 and self-certification forms. Badges must be obtained prior to performing work; therefore, the contractor shall integrate the anticipated badging schedule into the overall construction schedule.
   3. Before starting work the General Contractor shall give one week’s notice to the Contracting Officer so that security escort can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
   4. All employees of general contractor and subcontractors shall have successfully passed background checks required to work on Government networks.
   5. No photography of VA premises is allowed without written permission of the Contracting Officer. Patients and staff are not to be photographed at any time.
   6. VA reserves the right to close down or shut down the project site and order General Contractor’s employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

7. Contractor shall secure all Telecom Room spaces at the end of each day.
8. Ceiling tiles must be in place at the end of each working day to provide smoke barrier.
9. VA Engineering or OIT staff are not available to continuously escort and monitor Contractor activities. Escorts will be determined by the VA at the time of procurement.

C. Key Control:
1. Contractor will be issued VA Keys and will require a signature confirming that they received the key(s) listed on signature form. General Contractor is responsible for returning these keys upon separation of project or at any time the VA requests. Lost or misplaced keys are to be reported to VA COR immediately and additional costs to replace keys and all cores associated with that key series will be calculated at that time with the VA Locksmith Shop and charged to the contractor.
2. The General Contractor may not duplicate Government issued keys.
3. The General Contractor shall provide duplicate keys and lock combinations to the Contracting officers representative (COR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
4. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.

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

E. Motor Vehicle Restrictions
1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.
2. A limited number of (2 to 5) permits shall be issued for General Contractor and its employees for parking in designated areas only. Contractor to coordinate with VA Medical Center Facility Manager.

1.7 OPERATIONS AND STORAGE AREAS (FAR 52.236-10)

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold

and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

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

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

E. Workers are subject to rules of Medical Center applicable to their conduct.

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

G. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.
   1. Do not store materials and equipment in other than assigned areas.
   2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
   3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

H. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR . All such actions shall be coordinated with the COR or Utility Company involved:
   1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

I. Phasing:
   1. The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks. The work to be outlined shall include, but not be limited to:

J. To ensure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to ensure accomplishment of this work in successive phases mutually agreeable to Medical Center Director, COR and Contractor

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

L. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:
1. Contractor shall maintain a minimum temperature of 60 degrees F at all times.
2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

M. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. No energized work will be permitted and temporary electrical service shall be provided at contractor’s expense to maintain operations. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY for additional requirements.
2. Contractor shall submit a request to interrupt any such services to COR, in writing, 14 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 30 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

N. Temporary utility services: Contractor shall provide temporary services for all trades to ensure no loss of service to the VA Medical Center (e.g., HVAC, plumbing, electrical, communications,

and/or security). Contractor is responsible for furnishing, installing, commissioning and decommissioning all temporary systems.

1. Temporary electrical service and generators must be provided by the General Contractor whenever an outage is required. For Mission Critical telecommunications areas, temporary service will include temporary panels, UPS and other equipment to maintain 2N or N+1 redundancy, as required by the space.
2. Temporary HVAC shall be provided for all locations requiring a shut-down of existing systems, Temporary HVAC cooling and/or heating capacity shall match existing at a minimum. For Mission Critical spaces (such as a Main Computer Room), 2N or N+1 redundancy shall be maintained.

O. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, shall be removed back to their source. Those which are indicated to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely in interstitial spaces.

P. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:

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

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

1.8 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and a representative of VA Supply Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
3. Shall note any discrepancies between drawings and existing conditions at site.
4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a

report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:

1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workers in executing work of this contract.

D. Protection: Provide the following protective measures:

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

1.9 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:

1. Reserved items which are to remain property of the Government as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

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

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

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

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

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
   1. Designating areas for equipment maintenance and repair;
   2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
   3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
   4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
   5. Providing adequately maintained sanitary facilities.

1.11 RESTORATION

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

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

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

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

1.12 AS-BUILT DRAWINGS

A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
   1. Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.
   2. As-built drawings are to be provided, with a copy of them on AutoCAD version 2020 or later provided digitally. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

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

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

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

1.13 WARRANTY MANAGEMENT

A. Warranty Management Plan: Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction at least 30 days before the planned pre-warranty conference, submit four sets of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesman, or of engineering background, not necessarily familiar with this contract. The term “status” as indicated below must include due date and whether item has been submitted or was approved. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly invoice for payment. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of the project acceptance and continue for the product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contactor and the Contracting Officer. Include in the warranty management plan, but not limited to, the following:
   1. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the company of the Contractor, subcontractors, manufacturers or suppliers involved.
   2. Furnish with each warranty the name, address and telephone number of each of the guarantor’s representatives nearest project location.
   3. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers and for all commissioned systems such as fire protection and alarm systems, sprinkler systems and lightning protection systems, etc.
   4. A list for each warranted equipment item, feature of construction or system indicating:
      a. Name of item.
      b. Model and serial numbers.
      c. Location where installed.
      d. Name and phone numbers of manufacturers and suppliers.
      e. Name and phone numbers of manufacturers or suppliers.
      f. Names, addresses and phone numbers of sources of spare parts.
      g. Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
      h. Starting point and duration of warranty period.
      i. Summary of maintenance procedures required to continue the warranty in force.
      j. Cross-reference to specific pertinent Operation and Maintenance manuals.
      k. Organizations, names and phone numbers of persons to call for warranty service.
      l. Typical response time and repair time expected for various warranted equipment.
   5. The plans for attendance at the 4 and 9-month post construction warranty inspections conducted by the government.
   6. Procedure and status of tagging of all equipment covered by extended warranties.
   7. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

B. Performance & Payment Bonds: The Performance & Payment Bonds must remain effective throughout the construction period
   1. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others,

and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

2. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the contractor's expenses, the Contracting Officer will have the right to recoup expenses from the bonding company.
3. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Contracting Officer to proceed against the Contractor.

C. Pre-Warranty Conference: Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/ reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contract will be located within the local service area of the warranted construction, be continuously available and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in conjunction with other portions of this provision.

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

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

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

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

e. Code 1-Electrical
1) Power failure (entire area or any building operational after 1600 hours).
2) Security lights.
3) Smoke detectors.

f. Code 2-Electrical
1) Power failure (no power to a room or part of building). Receptacle and lights not operational (in a room or part of building).

g. Code 3-Electrical
1) Exterior lights not operational.

h. Code 1-Gas
1) Leaks and pipeline breaks.

i. Code 1-Heat
1) Power failure affecting heat.

j. Code 1-Plumbing
1) Hot water heater failure.
2) Leaking water supply pipes

k. Code 2-Plumbing
1) Flush valves not operating properly
2) Fixture drain, supply line or any water pipe leaking.
3) Toilet leaking at base.

l. Code 3- Plumbing
1) Leaky faucets.

m. Code 3-Interior
1) Floors damaged.
2) Paint chipping or peeling.
3) Casework damaged.

n. Code 1-Roof Leaks
1) Damage to property is occurring.

o. Code 2-Water (Exterior)
1) No water to facility.

p. Code 2-Water (Hot)
1) No hot water in portion of building listed.

q. Code 3
1) All work not listed above.

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

G.

Warranty Tags
Type of product/material
Model number
Serial number
Contract number
Warranty period from/to
Inspector's signature
Construction Contractor
Address

Warranty Tags
Telephone number
Warranty Contact
Address
Telephone number
Warranty response time priority code

1.14 USE OF ROADWAYS

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

1.15 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to written approval and compliance with the following provisions:
   1. Permission to use each unit or system must be given by COR in writing. If the equipment is not installed and maintained in accordance with the written agreement and following provisions, the COR will withdraw permission for use of the equipment.
   2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Installation of temporary electrical equipment or devices shall be in accordance with NFPA 70, National Electrical Code, (2014 Edition), Article 590, *Temporary Installations.* Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
   3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
   4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
   5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
   6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.

B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.

C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

D. Any damage to the equipment or excessive wear due to prolonged use will be repaired replaced by the contractor at the contractor’s expense.

1.16 TEMPORARY USE OF EXISTING ELEVATORS

A. Use of existing freight elevator for handling building materials and Contractor's personnel will be permitted subject to following provisions:
   1. Contractor makes all arrangements with the COR for use of elevators. The COR will ascertain that the freight elevator is in proper condition. Contractor may use elevator for special nonrecurring time intervals when permission is granted. Personnel for operating elevators will not be provided by the Department of Veterans Affairs.
   2. Contractor covers and provides maximum protection of following elevator components:
      a. Entrance jambs, heads soffits and threshold plates.
      b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
      c. Finish flooring.
   3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes at the contractors expense.

1.17 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by COR, provide suitable dry closets where directed. Keep such places clean and free from flies and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.18 AVAILABILITY AND USE OF UTILITY SERVICES

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

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

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

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

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

F. Water (for Construction and Testing): Furnish temporary water service.
   1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.

2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR discretion) of use of water from Medical Center's system.

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

1.19 TESTS AND THIRD-PARTY INSPECTIONS

A. All testing shall be by certified testing laboratories and Third-Party Inspection subcontracted by the General Contractor per Section 01 45 29, TESTING LABORATORY SERVICES.
1. The VA shall not be required to contract testing for any trade.

B. Inspections:
1. The VA does not provide courtesy, pre-inspections of construction area and systems during the construction. The Contractor shall request progress inspections and communicate requests for inspections at least one week in advance.
2. Comprehensive 3rd party inspections, testing and written reports for all Divisions (paid by the General Contractor).
   a. Contractor shall employ third party inspection consultants to perform all inspections required by this contract. The VA has no inspection capability. Any reference to VA inspections shall be by a third-party inspector qualified to perform the work. Credentials shall be supplied to the VA/AE as required by this contract. All inspections, testing, certifications, and permits are to be paid for by the General Contractor. The VA will not pay for or perform any required inspections. VA inspections are for VA use only, when performed, and do not reduce the inspection burden on the Contractor for conformance to the Contract Documents. Third-party inspection services must be submitted for acceptance by the VA after award. Submission to include resumes of inspectors, with alternates, projected days on site, qualifications of inspectors showing similar projects, related portfolio, and description of communication protocol with Owner.
   b. Contractor shall notify VA COR minimum (7) days in advance of each third-party inspection to allow coordination with VA personnel.
   c. Third-Party Inspectors shall have minimum qualifications as detailed in “01 45 00 Quality Control CQC Part 3.2 Personnel Experience Matrix”.
   d. Acceptable Third-Party inspectors include the following examples:
      1) Parsons Brinckerhoff
         a) http://www.wsp-pb.com/en/WSP-USA/What-we-do-USA/Services/All-Services-A-Z/Bridge-Engineering/Construction-Inspection/
      2) Booz Allen
         a) http://www.boozallen.com
      3) US Army Corps of Engineers
         a) http://www.usace.army.mil/
      4) Bureau Veritas
         a) http://www.bureauveritas.com/
      5) Stantec
         a) http://www.stantec.com/our-work/services/construction-qa-qc-monitoring-inspection- services.html
      6) HDR, Inc.
         a) http://www.hdrinc.com/
      7) Gilbane
         a) http://www.gilbaneco.com.
      8) The individuals or specified technical companies shall be subject to acceptance by the Contracting Officer or Authorized designee.
   e. Minimum inspections required:

1) Structural.
2) Mechanical.
3) Electrical.
4) Plumbing.
5) Fire Protection.
6) Low Voltage Systems.
7) Communications and Security Systems.
8) Controls System Integration.
9) Commissioning Support.
10) Framing, Interior Finishes and Doors/Hardware.

3. Special Inspections per Section 01 45 35, SPECIAL INSPECTIONS.
4. All third-party, Special Inspections Reports shall be recorded and submitted before Commissioning Systems Functional Performance Test start.

C. As per specification section 01 91 00, 01 45 00 and 23 05 93 the contractor shall provide a written testing and commissioning plan complete with component level, equipment level, sub-system level and system level breakdowns. The plan will provide a schedule and a written sequence of what will be tested, how and what the expected outcome will be. This document will be submitted for approval prior to commencing work. The contractor shall document the results of the approved plan and submit for approval with the as built documentation.

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

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

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

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

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

1.20 INSTRUCTIONS

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

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

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

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

1.21 RELOCATED EQUIPMENT AND ITEMS

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

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

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

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

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

1.22 CONSTRUCTION SIGN

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

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

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

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

1.23 SAFETY SIGN

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

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

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

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

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

1.24 HISTORIC PRESERVATION

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

1.25 APPENDICIES

A. Appendix A – ISTS

B. Appendix B – Submittal Log

C. Appendix C – VHA ICRA Template

D. Appendix D – VHA PCRA Template

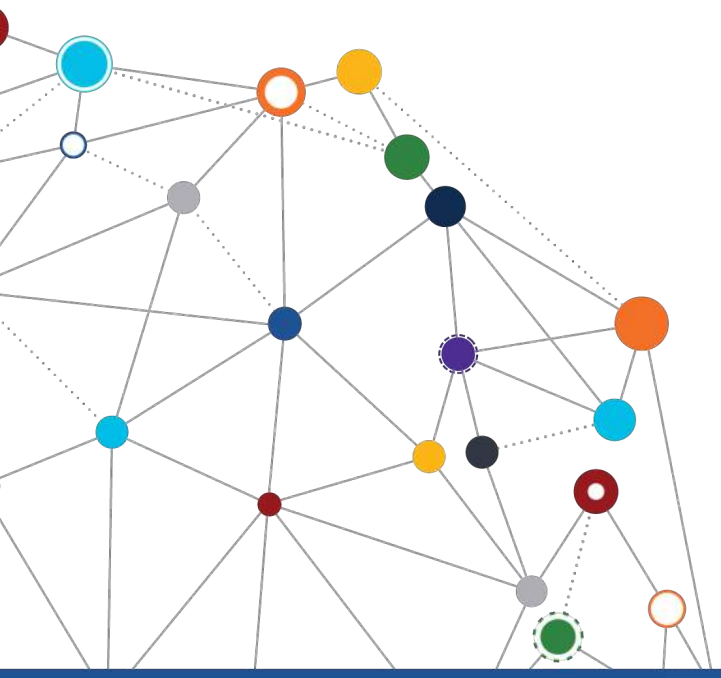
- - - E N D - - -

OFFICE OF
INFORMATION
AND TECHNOLOGY

Infrastructure Standard for Telecommunications Spaces (ISTS)

Version 4.0

June 1, 2023 | Infrastructure Operations (IO)



VA | U.S. Department of Veterans Affairs
Office of Information and Technology

Revision History

Table 1: Revision History

Date	Reason for Changes	Version	Author
2007	Original	0.1	Michael Julian, RCDD
2009	Revision	0.2	Michael Julian, RCDD
2012	Revision	1.0	Michael Julian, RCDD
12/07/2016	Enterprise Data Center Infrastructure Collaboration Team (EDICT) Revision	1.1	EDICT
2/05/2018	– Expanded revision including the addition of Administrative and Operations Standards – Name changed to include IT Support Infrastructure to reflect broader scope	1.2	EDICT
6/11/2018	– Minor update to allow for deeper network racks in cooperation with IO's request – Expanded allowance for fiber cabinets, cassettes, patch panels, and racks – Changed National Data Center Operations & Logistics (NDCOL) facility ID numbers to VA Record ID numbers – Clarified reference to OIT responsibility for the enterprise-wide technical framework and IT architecture services	2.1	EDICT
4/10/2019	– Name updated from "VA Enterprise Facility IT Support Infrastructure Standard" to "Infrastructure Standard for Telecommunications Spaces" – Minor editorial changes resulting from initial review by the Office of Construction and Facilities Management (CFM) Facilities Standards Service (FSS) for publication in Technical Information Library (TIL) – Removed operational information not required for building planning and design for publishing of the Standard on the TIL. Information redacted will be published as part of the Operations and Maintenance Standards for Telecommunications Spaces. In the interim, refer to the June 11th, 2018 version 2.1 of The Standard on the Baseline Configuration Management (BCM) Standards site. – 508 compliance updates	2.2	EDICT CFM

Date	Reason for Changes	Version	Author
8/21/2020	– Editorial changes resulting from full review by CFM FSS for publication in CFM's TIL – Updated Telecommunications Room (TR), entrance room, and electrical power standards – Added grounding and bonding, transformers, intra-building/inter-building cabling, lighting, and lightning protection system sections, and Request for Variance process instructions – Created VA-modified Data Center Facility Environment Conditioning Standards figure to replace ASHRAE's less stringent requirements – Reorganized sequence of chapters for a more logical flow of data center design. Refer to the Table of Contents and the associated links to quickly find any subject of interest – Relocated Figures, Tables, Definitions, References, and Acronyms sections to front matter for consistency with Telecommunication Industry Association (TIA) formats – Added appendices to include Request for Variance form and OIT Design Guide Template Design Package	3.0	EDICT CFM
7/1/21	– 4.2.8 Bonding and Grounding: changed "supplementary" ground path to "dedicated" so it cannot be confused with SBNs, SRGs, Mesh-BNs, etc. – 4.4.4 Fiber Optic Cable: relaxed authorization for Universal Cassettes to be used when breaking out to LC connectors – Appendix B Sheet 2: corrected split package air conditioner heat rejection requirement to be 17,000 BTU/h (5 kW) per rack – Appendix B Sheet 3: corrected layer issue masking attributes and specifications on certain lines in the table – Appendix B Sheet 21: corrected layer issue masking a Power Distribution Units (PDU) on left side of Plate 1	3.1	EDICT

Date	Reason for Changes	Version	Author
5/1/23	– Clarified TR sizing and rack count for small clinical environments and non-medical spaces per serving area – Added Telecommunications Enclosure (TE) specifications – Added antenna entrance room specifications – Added IT Equipment Power Cord section – Harmonized the Environmental Control Equipment Requirements section with the HVAC DM – Added a Fans and Supplemental Airflow Augmentation Device section – Added a Physical Access to Telecommunications Spaces section – Enhanced the Structured Cabling section to differentiate between campus structured cabling and data center structured cabling – Updated the Request for Variance form – Reorganized Appendix B Design Templates into sections to assist with navigation to specific topics; Telecommunications Spaces (Architectural), Telecommunications Enclosure (TE), Electrical Distribution and Bonding, Telecommunications Distribution (Elevations, Cabling, and Routing), and Basis of Design Equipment. – Added sheets for TEs, antenna entrance rooms, Power Distribution Unit (PDU), Uninterruptible Power Supply (UPS), temperature and humidity sensors, horizontal distance study (Diamond Analysis), electrical one-line drawings, cable routing, telecommunications spaces rack elevations, and the rule of thirds. – Added new switch models to the bonding page, clearances around racks and power panels, and separated out the fiber from the copper media into individual sheets. – Changed the light fixtures from 2 ft to 4 ft and replaced the 40 in. Chatsworth Network Cabinet with the Great Lakes Cabinet, and the Chatsworth Terraframe with the ZetaFrame replacement model.	4.0	EDICT

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1 Introduction

1.1 Purpose

The Infrastructure Standard for Telecommunications Spaces (ISTS) serves as the master reference document of criteria for Department of Veterans Affairs (VA) facility Information Technology (IT) support infrastructure. It defines the technical requirements necessary to maintain optimum reliability and efficiency within VA facilities and computing centers.

1.2 Scope

The ISTS shall be applied to all aspects of IT support infrastructure at all VA owned, operated, and leased spaces. "All aspects" includes, but is not limited to planning, design, construction, sustainment (operations, maintenance, repair), restoration, modernization, and administration. "All VA spaces" includes but is not limited to VA Central Office (VACO) facilities and all field facilities managed by Veterans Health Administration (VHA), Veterans Benefits Administration (VBA), and the National Cemetery Administration (NCA).

IT Support Infrastructure is defined as all passive telecommunications and IT equipment, and supporting physical space and equipment, which includes the following:

- Copper and fiber cabling Information Transport Systems (ITS)
- IT equipment and systems (servers, storage, network switching and distribution, etc.)
- Telecommunications spaces, Telecommunications Rooms (TR), entrance rooms, antenna entrance rooms, data centers, horizontal distribution pathways, vertical distribution pathways, etc.
- Telecommunications equipment and systems (local and wide area network, telephone, cable television, physical security IT system, etc.)
- Physical infrastructure equipment and systems necessary to support active equipment operations at the required availability and sustainability levels (power distribution, environmental conditioning, monitoring and metering equipment, grounding, etc.)

1.3 Administration

The Standard shall be implemented without modification, except when required by an Authority Having Jurisdiction (AHJ), Federal, state, or local laws and codes. Additional requirements of AHJs shall be provided to enterprise Data Center and Infrastructure Engineering (DCIE) for evaluation of project application and possible amendment of the Standard.

Projects in the planning, design, or implementation phases impacting telecommunications distribution, space allocation, layout, electrical distribution, or mechanical systems shall contact DCIE for assistance in telecommunications space design and standards compliance.

Existing IT support infrastructure that does not conform to the ISTS shall be brought into compliance during routine tech refresh, lifecycle replacement, upgrades, new installations, or renovations of existing space.

Facility managers should take every opportunity to bring telecommunications spaces into compliance with the ISTS through incremental changes between scheduled sustainment activities.

Area Managers shall ensure that all contracting officers, IT personnel, and engineering staff are aware and make use of the ISTS.

All staff that routinely access telecommunications spaces require initial basic and annual telecommunications training. Area Managers and supervisors shall assign the approved annual list of OIT telecommunications courses corresponding to the role of the staff member.

1.3.1 Request for Variance from Infrastructure Standards

Requests for variance for allowable deviations from specific requirements of any standards published within may be authorized where a proposed alternate method of installation or operation will provide equal or higher safety, reliability, redundancy, or sustainability objectives. Requests for variance shall be submitted for consideration to DCIE (VAITESEDatacenterEngineering2@va.gov) using a Request for Variance form. If a variance is granted, it shall be limited to the particular site and installation covered in the application and will NOT be considered as a precedent for other installations.

Note: This is a separate process from VHA's process and form for requesting variances from other TIL standards and design manuals.

1.3.2 Request for Change to Infrastructure Standards for Telecommunications Spaces

Requests for changes shall also be submitted to DCIE (VAITESEDatacenterEngineering2@va.gov) for consideration using a Request for Variance form. If approved, the proposed change(s) will be ratified through the Enterprise Baseline and Standard Review (EBSR) process and submitted to the Enterprise Change Advisory Board (CAB) for final approval (if required) before publication.

1.3.3 Contact Information

Transmit all communications to DCIE (VAITESEDatacenterEngineering2@va.gov).

1.4 Standards Overview

The ISTS includes standard specifications, decisions supporting the standard specifications, guidelines, or recommendations for implementing the standard specifications, and supplemental factors to consider when evaluating subject components.

The Infrastructure and the Administration portions of the ISTS define the topologies and specifications for facilities and systems in the VA enterprise.

The Infrastructure Standards also provide guidance on procuring components that meet the standard specifications, guidance on integrating them with existing components, and explanation of how the subject components fit into the VA Enterprise Architecture.

The Administration Standards define the acceptable and recommended specifications for Inside Plant (ISP) naming conventions, including racks, equipment enclosures, fiber and Unshielded Twisted Pair (UTP) transport media, power distribution for active and passive elements, cable plant, and data center naming conventions.

1.4.1 Background

A standard is a set of rules or requirements that are determined by a consensus opinion of subject matter experts and prescribe criteria for a product, process, test, or procedure. The general benefits of a standard are quality, interchangeability of parts or systems, consistency, and reduction of lifecycle costs.

Telecommunications infrastructure standards are based on business needs provided through or supported by IT services. IT services are designed to support business processes and are constructed from software, hardware, and infrastructure components.

Establishing and enforcing standards for the selection and configuration of these supporting components improves the capacity, sustainability, maintainability, reliability, and availability of IT services within projected economic constraints in alignment with business needs.

1.4.2 Future

At the time of this publishing, a separate document, the Operations and Maintenance (O&M) of Telecommunications Spaces Standard is being developed as a companion piece to the Standard. The O&M Standard will describe facility computer room operation specifications, management of telecommunications cabling, and management of airflow.

1.5 Objectives

This Standard provides specifications for use across all VA facilities to support:

- Requirement development
- Solution design
- Solution evaluation
- Solution procurement and bid evaluation
- Evaluation of architectural specifications
- Standardization of passive ISP and Outside Plant (OSP) infrastructure
- Standardization of design criteria for telecommunications spaces, facilities physical infrastructure systems, and operation and maintenance of systems supporting VA services
- Standardization of naming and identification conventions for VA data centers
- Standardization of ISP and rack power infrastructure naming conventions

- Standardization of labeling and identification conventions for physical plant systems and components
- Standardization of operations
- Operational solution procurement and bid evaluation
- Evaluation of maintenance, repair, and replacement specifications
- Standardization of lifecycle sustainment activities across all VA data centers
- Standardization of the operational, organizational, and aesthetic results of Sustainment, Restoration, and Modernization (SR&M) activities

1.6 Authority

Office of Information and Technology (OIT) is the chartered organization responsible for the enterprise-wide technical framework and IT architecture services for VA systems and projects. Centralized responsibility promotes one technology vision across VA, which supports system optimization, integration, and interoperability throughout the enterprise.

One way in which OIT executes this responsibility is determining technical standards for deployed infrastructure technologies. These standards are also known as configuration baselines. The authority of the ISTS derives from the approved enterprise configuration baselines.

2 IT Support Space Classification

VA has four segregated IT Support Space types to support the enterprise distributed computing environment.

- Core Data Centers (CDC) provide enterprise-level support services for VA-wide and cross-component systems and applications.
- Mission Support Centers (MSC) are highly specialized data centers that provide unique, focused services that are best provided from smaller, mission-focused facilities that cannot or should not be supported by CDCs or Campus Support Centers (CSC) due to the direct association MSCs have with mission-specific infrastructure or equipment.
- Campus Support Centers (CSC) operate local data centers to support VA tenants located on a VA campus and within geographically supported areas. CSCs provide services that cannot be provided (technically or economically) from a CDC. Only one CSC is authorized per VA campus.
- Network Support Centers (NSC), provide lower-level application and IT services distribution across the geographic breadth of the VA's computing enterprise, enabling special functions and distributed users to satisfy the specific mission. *Note: Telecommunications Rooms typically follow NSC rating classification and redundancy requirements.*

There shall be a single data center per VA campus. Additional computer rooms used to house and operate IT server or storage equipment are not authorized. This follows with the converged physical telecommunications infrastructure networking model where backbone is distributed from the data center to TRs and other distributed telecommunications spaces, and horizontal distribution supports end-user requirements in the serving zones of these distributed telecommunications spaces. The data center on campus is the only IT support space with the redundancy and resiliency characteristics to support end-user server and storage requirements appropriately.

2.1 Core Data Centers

Core Data Centers (CDC) are facilities that provide shared and distributed enterprise services to supported sites. CDCs host cloud services to provide complete end-to-end IT services (including but not limited to application, backup, and storage) to the supported VA sites.

The CDC architecture is considered mission-essential and is designed, operated, and maintained to provide availability consistent with current VA national data center standards for supported IT applications. CDCs are the target architecture component for IT services that span multiple Department components and user groups (services and applications used by many or all users, such as messaging, productivity, and collaboration).

CDCs may be VA-owned, leased, or government or commercial outsourced (external cloud) data centers. CDCs meet (or are planned to meet) all published CDC physical infrastructure requirements to ensure enterprise reliability, redundancy, high availability, and Disaster Recovery (DR) requirements.

CDCs may also provide services designated to be provided by an NSC if no local NSC to provide those services is available. CDCs may also provide MSC-type application support.

2.2 Mission Support Centers

Mission Support Centers (MSC) provide element-specific and single-instance special enterprise services that may be inappropriate for consolidation to CDC facilities. MSCs are the target architecture for specialized-function systems and applications, particularly those that support a specific but limited local or distributed user group (services allowing the Department to function but with a limited user base such as internal financial management, or applications requiring centralized processing for a small number of user facilities, such as consolidated pharmacies).

MSC physical requirements supporting the computing environment may be more lenient than those for CDCs. Specific requirements will vary based on the supported functions, criticality of the mission, and similar criteria. For example, MSCs designated as enterprise Test and Development environments will not require the same level of high-availability physical and network redundancy as a mission-critical production environment that directly supports patient care.

MSCs may also provide services designated to be provided by an NSC if no local NSC to provide those services is available.

2.3 Campus Support Centers

Campus Support Centers (CSC) provide geographically specific, operational IT services in support of campus services to Veterans and VA employees that cannot be effectively consolidated or provided over cloud architectures to the campus.

CSCs are intended to provide for collocation of IT equipment and systems from all provider organizations including Veterans Affairs Medical Centers (VAMC), VBA Regional Offices, Office of Information Field Office (OIFO), Research & Development (R&D), Police, Security, local Facilities Management Service (FMS), Health Informatics, Clinical Engineering (CE), etc. into the minimum number of operational spaces on a campus; that is, consolidated data centers providing environmental and area network support appropriate to all IT equipment needed by tenant organizations on a particular campus to perform their missions.

CSCs shall provide NSC services for their supported campuses.

2.4 Network Support Centers

Network Support Centers (NSC) provide local IT services that cannot be effectively consolidated or provided over a network-supported distributed architecture to the local operational site. Local means to the immediate facility and to facilities within the local commuting/networking area for the purposes of this architecture; NSCs may provide application support for all VA facilities in a metropolitan area, for example.

An NSC is the appropriate target environment where application architecture and network requirements require a closer data center point of presence to enable end users effective, efficient system access.

Table 2: Data Center Classification Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Core Data Center (CDC)	Description	CDCs are centralized data centers that provide enterprise-level services to geographically-distributed VA organizations to support business functions. CDCs shall maintain complete High Availability (HA) and DR.
		Planned ANSI/TIA-942-B Rating	3
		Examples	• Information Technology Center (ITC) • Regional Data Center (RDC)
2	Mission Support Center (MSC)	Description	MSCs are stand-alone data centers that provide specific enterprise IT functionality to VA organizations and business functions.
		Planned ANSI/TIA-942-B Rating	2 or 3
		Examples	• Test/Dev data centers at Rating 2 • Centralized Mail Outpatient Pharmacy (CMOP) • Consolidated Patient Account Center (CPAC)
3	Campus Support Center (CSC)	Description	CSCs are stand-alone data centers that provide specific IT functionality to a VA campus supporting all VA tenants on that campus and in the geographically supported area.
		Planned ANSI/TIA-942-B Rating	3
		Examples	• VA Medical Center (VAMC) • CBOCs 50,000 ft² and over • Health Care Center (HCC)
4	Network Support Center (NSC)	Description	NSCs are local data centers that provide local IT application and network support to local operating locations.
		Planned ANSI/TIA-942-B Rating	1

ID	Primary Attribute	Secondary Attribute	Specification
		Examples	• CBOCs under 50,000 ft² • VBA Regional Offices • TRs • Non-healthcare facility entrance rooms (healthcare facility entrance rooms and antenna entrance rooms inherit the Rating 3 redundancy requirements of their CSC) • Other server rooms of limited capacity design (not “shallow rooms”) • Administrative office space server rooms

Evaluation Factors

- Data center facility appropriately and centrally categorized by function and usage
- Capability gaps between existing and planned ANSI/TIA942B Rating requirements identified.

3 Information Technology Support Space Planned Redundancy Levels

VA IT support spaces shall be designed and operated in accordance with the ANSI/TIA-942-B Ratings for each data center type, except as detailed specifications are provided in this and other VA data center facilities standards.

These specifications define the minimum system redundancy levels for the physical plants and facilities physical infrastructure systems that support enterprise data centers. This Standard shall be used to quantify and qualify designs of physical infrastructure supporting data center facilities and spaces when those spaces are being designed, built, retrofitted, refreshed, and updated.

The minimum design redundancy levels for new and replacement systems in IT support spaces are detailed below. These designs balance system implementation and operation cost against availability needs for each type of space. In planning physical infrastructure system projects, reduction of potential single points of failure is generally considered more critical than increasing the redundancy level of a system.

From a design perspective on a system+system (2N) design, the smaller capacity of the two individual systems is considered the overall system capacity. For instance, a 2N system with a 500 kW side and a 750 kW side has a maximum capacity of 500 kW.

Redundancy is represented relating to the need (N). If no redundancy is required, the system simply has a redundancy level of N. To gain the simplest form of redundancy, one additional system is added represented by N+1. For example, if two Computer Room Air Conditioners (CRAC) are needed to meet the cooling need of the data center, then to obtain an N+1 redundancy level a third CRAC must be added. To provide further redundancy a 2N system could be put in place. In the CRAC example, four CRACs would create a 2N system. Furthermore, for a 2N+1 system, five CRACs would be required to meet this level of redundancy. Finally, for a 2(N+1) system, six CRACs would be required.

Implementation Guidance

Where N+C redundancy is required for environmental control systems in CDCs, be aware that design considerations including total number and capacity of CRAC units, spacing of units in planned designs, and geometries of computer room spaces may dictate that one, two, three, or more units more than the N requirement may be necessary to ensure appropriate environmental control in all contingency situations. Computational Fluid Dynamics (CFD) modeling is required to understand the airflow and determine the effect of teaming various combinations of CRAC units and adjustment of settings.

Redundancy Level	Generic System Diagram
N	
N+1	
2N	
2N+1	
2(N+1)	

Circled loads are active.

Figure 1: Generic Redundancy Level Standards for Physical Plants, Facilities, and Infrastructure Systems

Table 3: Data Center Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	Core Data Center (CDC)	N+1 redundant feed: one commercial power source (also known as utility), one generated power (also known as emergency)
		Mission Support Center (MSC)	N+1 redundant feed (one commercial, one generated) for a Rating 3 facility or single feed (N) for a Rating 2 facility
		Campus Support Center (CSC)	N+1 redundant feed (one commercial, one generated)
		Network Support Center (NSC)	N (one commercial)
2	Emergency Power Generation Source	Core Data Center (CDC)	N+1
		Mission Support Center (MSC)	N for Rating 2 facility and N+1 for Rating 3 facility.
		Campus Support Center (CSC)	N+1
		Network Support Center (NSC)	• Provide emergency power to TRs IAW the VA Electrical Design Manual when supporting medical center with a CSC • Not required but recommended to support other medical and non-medical facilities
3	Uninterruptible Power Supply (UPS) Technical Power Systems	Core Data Center (CDC)	2N
		Mission Support Center (MSC)	N+1 (distributed redundant modules or block redundant system with dedicated battery string for each module)
		Campus Support Centers (CSC)	2N
		Network Support Center (NSC)	N (single UPS system, single battery string)
4	Electrical Distribution (UPS to IT equipment)	Core Data Center (CDC)	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)

ID	Primary Attribute	Secondary Attribute	Specification
		Mission Support Center (MSC)	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Campus Support Center (CSC)	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Network Support Center (NSC)	N
5	Environmental Support (HVAC)	Core Data Center (CDC)	• N+1. If more than five CRACs, then N+C where C=1 for every five to eight CRACs needed • Brief interruptions to electrical power (<10 min) will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Mission Support Center (MSC)	• N+1 • Brief interruptions to electrical power (<10 min) will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Campus Support Center (CSC)	• N+1 • Brief interruptions to electrical power (<10 min) will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Network Support Center (NSC)	N

3.1 Core Data Center and Campus Support Center Planned Redundancy Levels

Table 4: Core Data Center and Campus Support Center Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N+1 redundant feed (one commercial, one generated)
		Distribution Paths	One active, one standby (one commercial feed, one standby generation, Automatic Transfer Switch (ATS))
		System (N) Capacity	Total facility design capacity (either commercial feed or generator can provide 100 % of the facility's design load)
2	Emergency Power Generation Source	System Redundancy Components	N+1
		Distribution Paths	Single path ATS
		System (N) Capacity	Total facility design capacity (generator source can provide all critical mechanical and electrical support for the facility)
3	UPS Technical Power Systems	System Redundancy Components	2N
		Distribution Paths	Two simultaneously active (A/B configuration)
		System (N) Capacity	• Each UPS system (A/B) rated for 100 % of data center design load • Modular systems sized for ultimate design load but only populated to current load needs is preferred
		UPS Technology	Two delta conversion or double conversion UPS systems
4	Electrical Distribution (UPS to IT equipment)	System Redundancy Components	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)
		Distribution Paths	Two simultaneously active (A/B distribution from UPS)
		System (N) Capacity	Maximum design loading of all components with one distribution path offline

ID	Primary Attribute	Secondary Attribute	Specification
5	Environmental Support (HVAC)	System Redundancy Components	• N+1. If more than five CRACs, then N+C where C=1 for every five to eight CRACs needed • Brief interruptions to electrical power (<10 min) will not cause loss of cooling but may cause temperature to elevate within operational range of critical equipment
		Redundancy Configuration	One alternate
		Power Source	• Each CRAC and its associated heat rejection equipment for that CRAC powered from the same source • Sets of heat rejection systems diversely powered (from differing sources) • Design power sources to provide maximum reasonable avoidance of single points of failure
		System (N) Capacity	Total facility design capacity

Implementation Guidance

Uninterruptible Power Supply (UPS) systems shall be sized for the ultimate design load of the telecommunications space. For initial cost, maintenance, reliability, and efficiency reasons, modular UPS systems built out to provide sufficient UPS and battery capacity to meet near-term requirements are preferred over full-capacity systems.

Both the A/B UPS systems shall be powered from generator-backed sources.

3.2 Mission Support Center Planned Redundancy Levels

Table 5: Mission Support Center Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N+1 Redundant Feed (one commercial, one generated) for a Rating 3 facility or Single feed (N) for a Rating 2 facility
		Distribution Paths	One active, one standby (one commercial utility feed, one standby generation, ATS)
		System (N) Capacity	Total facility design capacity (either source can provide 100 % of the facility's design load)
2	Emergency Power Generation Source	System Redundancy Components	• N+1 for a Rating 3 facility • N for a Rating 2 facility
		Distribution Paths	Single path ATS
		System (N) Capacity	Total facility design capacity (generator source can provide all critical mechanical and electrical support for the facility) for a Rating 3 facility or sized for UPS and mechanical system without redundancy for a Rating 2 facility
3	UPS Technical Power Systems	System Redundancy Components	N+1 (distributed redundant modules or block redundant system with dedicated battery string for each module)
		Distribution Paths	Two simultaneously active (A/B configuration)
		System (N) Capacity	• Each UPS system (A/B) rated for 100 % of data center design load • Modular systems sized for ultimate design load but only populated to current load needs are preferred
		UPS Technology	Delta conversion or double conversion UPS systems
4		System Redundancy Components	2N (mirrored A/B distribution from UPS to rack in support of all IT systems)

ID	Primary Attribute	Secondary Attribute	Specification
	Electrical Distribution (UPS to IT equipment)	Distribution Paths	• Two simultaneously active (A/B distribution from UPS systems to Power Distribution Units (PDU) to the Master Power Distribution Unit (MPDU)) • Redundant, diverse path, and follows rectilinear pathways when not contained in a cable tray
		System (N) Capacity	5 kW capacity for each enclosure
5	Environmental Support (HVAC)	System Redundancy Components	• N+1 • Temporary loss of electrical power will not cause loss of cooling, but may cause temperature to elevate within operational range of critical equipment for a Rating 3 facility or N+1 redundancy for mechanical equipment) • Loss of electrical power can cause loss of cooling in a Rating 2 facility
		Redundancy Configuration	One alternate
		Power Source	• Each CRAC and its associated heat rejection equipment for that CRAC powered from the same source • Sets of heat rejection systems diversely powered (from differing sources) • Design power sources to provide maximum reasonable avoidance of single points of failure
		System (N) Capacity	Total facility design capacity

Implementation Guidance

UPS systems shall be sized for the ultimate design load of the telecommunications space. For initial cost, maintenance, reliability, and efficiency reasons modular UPS systems built out to provide sufficient UPS and battery capacity to meet near-term requirements are preferred over full-capacity systems.

Both the A/B UPS systems shall be powered from generator-backed sources (for Rating 3 facilities).

3.3 Network Support Center, Telecommunications Room, Entrance Room, and Antenna Entrance Room Planned Redundancy Levels

Note: Healthcare facility entrance rooms and antenna entrance rooms inherit the TIA-942-B Rating 3 redundancy requirements of the CSC data center facility that they support.

Table 6: Network Support Center, Telecommunications Room, Entrance Room, and Antenna Entrance Room Planned Redundancy Levels

ID	Primary Attribute	Secondary Attribute	Specification
1	Facility Power Input Sources	System Redundancy Components	N (one commercial)
		Distribution Paths	One path
		System (N) Capacity	Total facility design capacity (commercial feed can provide 100 % of the facility's design load)
2	Emergency Power Generation Source	System Redundancy Components	• N+1 when supporting medical center with a CSC, not required, but recommended supporting other medical facilities and non-medical facilities • N required at all sites with facility generation capabilities
		Distribution Paths	• Minimum one path when supporting medical center with a CSC, not required, but recommended supporting other medical facilities and non-medical facilities • N required at all sites with facility generation capabilities
		System (N) Capacity	When provided, based on planned facility ultimate load
3	UPS Technical Power Systems	System Redundancy Components	• N (single UPS system, single battery string; may be individual rack-mount UPS systems for each rack) for NSCs and TRs • N for entrance rooms supporting NSCs and Rating 2 MSCs • 2N for entrance rooms and antenna entrance rooms supporting CSCs, CDCs, and Rating 3 MSCs

ID	Primary Attribute	Secondary Attribute	Specification
		Distribution Paths	• One path • Two simultaneously active (A/B configuration) for entrance rooms and antenna entrance rooms supporting CSCs , CDCs, and Rating 3 MSCs
		System (N) Capacity	• UPS system(s) rated for 100 % of critical IT system design load (5 kW per enclosure) • Modular systems sized for ultimate design load but only populated to current load needs are preferred
		UPS Technology	• Rack-mounted line interactive UPS systems (mechanical ATS optional) • Facility UPS
4	Electrical Distribution to IT equipment	System Redundancy Components	• 2N • A side shall be UPS-backed, B-side may be commercial • 2N both sides UPS-backed for entrance rooms and antenna entrance rooms supporting CSCs, CDCs, and Rating 3 MSCs
		Distribution Paths	Two paths simultaneously active (A/B configuration)
		System (N) Capacity	5 kW capacity for each enclosure
5	Environmental Support (HVAC)	System Redundancy Components	• N • N+1 for entrance rooms and antenna entrance rooms supporting CSCs, CDCs, and Rating 3 MSCs
		Redundancy Configuration	• None • One alternate for entrance rooms and antenna entrance rooms supporting CSCs, CDCs, and Rating 3 MSCs
		System (N) Capacity	Requirement varies based on the number of racks

Implementation Guidance

UPS systems shall be sized for the ultimate design load of the telecommunications space. For initial cost, maintenance, reliability, and efficiency reasons modular UPS systems built out to provide sufficient UPS and battery capacity to meet near-term requirements are preferred over

full-capacity systems. Modular UPS systems may not be available to meet rack-mounted applications.

Healthcare facility entrance rooms and antenna entrance rooms inherit the TIA-942-B Rating 3 redundancy requirements of the CSC data center facility that they support.

4 Infrastructure Standards

4.1 Architectural Standards and Space Design

VA telecommunications spaces, including entrance rooms, antenna entrance rooms, TRs, and data centers shall be designed and operated in accordance with the ANSI/TIA-942-B ratings for each data center classification, except as detailed specifications are provided in this and other VA data center facilities standards.

4.1.1 Building Specifications for Common Telecommunications Spaces

Table 7: Building Specifications

ID	Primary Attribute	Secondary Attribute	Specification
1	Shell	Security	As per Physical Security and Resiliency Design Manual (PSRDM)
		Access Route	Leads to location outside computer room for access control
		Egress	Observes life safety code
		Door Height (telecommunications spaces)	8 ft minimum
		Door Height (Mechanical Room)	9 ft minimum
		Door Width	• CSC, CDC, and MSCs- A 6 ft double doorway opening is required with or without a mullion. If center mullion is used, it must be removable. • NSC- 3 ft (nominal)
		Finished Floor to Lowest Structural Obstacle (clear space)	12 ft minimum
		Slab to Floor Above (MSC, CSC, CDC)	16 ft minimum
		Raised Floor (in new data center construction only if CFD analysis determines raised floor is the best cooling solution)	• 24 in. minimum above slab • Height determined by CFD analysis

ID	Primary Attribute	Secondary Attribute	Specification
		Floor Surface	• Electrostatic Discharge (ESD) coating for raised floor systems • Static dissipative coating or material for slab floors
		Bonding	Per manufacturer requirements
		Backboard	• 4 ft x 8 ft AC grade ¾ in. trade size fire-rated plywood backboard painted high-gloss white with two coats of fire-resistant paint for service provider/security/video/etc. around three perimeter walls of TRs, entrance rooms, antenna entrance rooms, and as required for computer rooms • Reserve an additional 12 in. dedicated space from backboards to accommodate equipment mounted on them
2	Raised Floor Tile	Dimensions	24 in. x 24 in. nominal
		Standard Tile	Placed by default everywhere perforated tiles and grates are not required by CFD
		Perforated Tile, High-Capacity Grates, and other High Airflow Tiles	• Only placed in the cold aisle in front of equipment inlets where CFD modeling predicts the optimum effectiveness • Positioned so that tiles are flush to the front of the row with directional airflow aimed towards the air inlets on IT equipment in the racks • Can be removed without interference from racks or cabinets

4.1.2 Data Center Layout Standards

Data centers will be designed in accordance with the specifications below, VA standards, and industry best practices listed in References.

CFD modeling shall be used to determine the most effective and cost-effective layout and containment solution for a given space (including new design/build, capability expansion, and lifecycle replacement). All data center designs for new data centers, expansion, or significant modification of existing data centers shall be approved through DCIE (VAITESEDatacenterEngineering2@va.gov).

Airflow separation of hot and cold air shall be a prime consideration when designing the floor layout and when selecting and procuring IT equipment. Equipment shall be specified, procured, configured, and installed so that the equipment draws cool air from the front face of the rack

and flows from the front of the rack to the rear or top of the rack and exiting either the rear door of the rack or the top through a Vertical Exhaust Duct (VED). Do not create conditions for exhaust to be recirculated back into cold air supply spaces.

Table 8: Data Center Floor Layout Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Aisles	Orientation	• Front of racks will be oriented toward cold aisle as in Figure 2 below • Front of racks will be aligned with each other to create a continuous linear aisle • If a raised access floor is used, front of racks will be flush with edge of floor tiles
		Width	• 4 ft minimum in cold aisles • 3 ft minimum in hot aisles (4 ft recommended)
		Cold Aisle	• Power cords if run in an access floor (with data cabling) will be placed in cable trays in cold aisles • Overhead power cords can be run either in the hot or cold aisles
		Hot Aisle	• Data cables if run in an access floor will be placed in cable trays in hot aisles • Power cords if run in an access floor (where data cabling is run overhead) will be placed in the hot aisle • Overhead power cords can be run either in the hot or cold aisles • Busways will be placed in the hot aisles
		Containment	Hot or cold aisle containment will be determined based on data center layout, HVAC configuration, and CFD analysis
2	Support Equipment	Computer Room Air Conditioners (CRAC)	Placement determined using CFD analysis
		Floor Stands	Manufacturer recommended floor stands for heavy equipment when raised access floor is used
		Power Distribution Units (PDU)	• Floor mounted PDUs are not to be placed within cold aisles • A-side and B-side PDUs will be aligned in a regular order to indicate power source

ID	Primary Attribute	Secondary Attribute	Specification
		Branch Circuit Panelboards (BCP) (also known as Remote Power Panels (RPP))	• Not to be placed within cold aisles • A-side BCP/RPPs aligned in a row • B-side BCP/RPPs aligned in a row
		Uninterruptable Power Supplies (UPS)	Placed in separate dedicated spaces or within the computer room IAW CFD
3	Equipment Rows	Length	No more than 14 racks/cabinets per row
		Orientation	No rows that terminate along a wall
		Cabinet/Rack/Cooling/ PDU/RPP Placement	• End of row racks or network cabinets shall be used for the Horizontal Distribution Area (HDA) to accommodate structured cabling • Gaps between adjacent racks and cabinets within each row are closed to eliminate internal paths of bypass and recirculation of air flows • Equipment cabinets will be used between the HDAs
		Clearance	• Ensure 3 ft minimum clearance from the front, back, and one side of each rack row to walls. The fourth side must not abut a wall and needs to leave 12 in. clearance • 4 ft minimum (6 ft recommended) distance from air conditioning and power distribution equipment (does not apply to in-row cooling/PDUs/RPPs) • Per manufacturer requirements • Per AHJ for egress

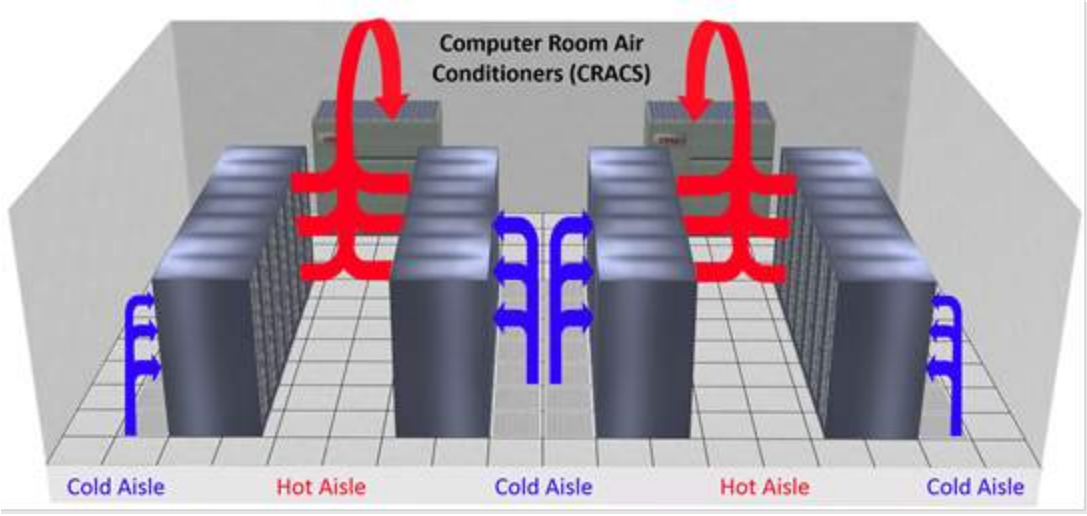

Figure 2: Hot Aisle/Cold Aisle Approach

Implementation Guidance

This Standard applies to new data center and telecommunications space construction as well as expansion, modification, and operation of existing facilities.

Engineered floor stands are required for CRACs, UPS battery cabinets, and other equipment capable of causing floor loading issues in raised floor environments.

VA shall not design or build "shallow rooms" or similar small spaces. Shallow rooms are intended only for access to vertical chases and riser cables installed there. Where a distribution TR is necessary in a location (i.e., the third floor of the west wing of a hospital), VA shall construct and operate out of a standardized TR.

4.1.3 Telecommunications Rooms

Telecommunications Rooms (TR) are a subset of the NSC classification archetype with less stringent environmental control requirements that:

- Serve as the transition point between the horizontal and backbone cabling systems
- Contain all networking, security, video distribution, paging, and any other system that serves the TR zone

There shall only be a single TR per serving zone. Additional TRs (or similar) are not authorized to support specific functions (e.g., FMS or CE). Likewise, TRs shall not be physically split or divided to separate organizational functions or for physical security purposes and shall not be designed, implemented, or operated. This follows with the converged physical telecommunications infrastructure networking model where backbone is distributed from the data center to TRs and other distributed telecommunications spaces and horizontal distribution supports end-user requirements in the serving zones of these distributed telecommunications spaces. The TR is the only IT support space in the serving zone that is supplied with backbone media suitable to support IT and IT-like system functions and designed with the redundancy and resiliency characteristics to support end-user equipment requirements appropriately.

Few TRs are exactly alike. OIT shall design or conduct design reviews of all projects involving new or renovated TRs to assure that the power, cooling, and room layout are consistent with VA and industry standards.

Evaluation Factors

- Floor area served
- Number of active Work Area Outlets (WAO) served
- Horizontal distribution distance

Implementation Guidance

Telecommunications Rooms for facilities providing healthcare (medical centers) shall be 170 ft² with a standard 4-rack configuration as shown in Appendix B. Provide approximately 2 ft linearly for each additional rack after four by extending the length of the TR for each rack required.

For non-medical spaces, TR sizing is dictated by the maximum quantity of *active* WAOs (the horizontal distribution cables that are patched to a switch port, actively supporting an end-user device) that can be operated in the TR (this aligns with the maximum quantity of 48-port switches that can be supported out of a TR of a given number of racks) in the supported serving zone.

In smaller clinical environments (e.g., CBOCs), smaller TRs may be specified: The more restrictive of the following two tables (serving area size and work area outlet count) will be used to determine TR sizing in smaller clinical environments (e.g., CBOCs) and non-medical spaces.

Table 9: Small Clinical Environment Racks and Telecommunications Room Sizing per Serving Area

ID	Primary Attribute	Secondary Attribute	Specification
1	Serving Area Size	< 6,000 ft²	1-rack TR (80 ft², 10 ft x 8 ft form factor)
		6,001-10,000 ft²	2-rack TR (100 ft², 10 ft x 10 ft form factor)
		10,001-25,000 ft²	3-rack TR (120 ft², 10 ft x 12 ft form factor)
		> 25,000 ft²	4-rack TR (170 ft, 10 ft x 12 ft form factor)

Table 10: Non-medical Space Racks and Telecommunications Room Sizing per Active Work Area Outlet Density in Supported Serving Zone

ID	Primary Attribute	Secondary Attribute	Specification
1	WAOs*	< 96 WAO	Telecommunications Enclosure (when meeting other TE criteria)
		< 144	1-rack TR (80 ft², 10 ft x 8 ft form factor)
		145-240	2-rack TR (100 ft², 10 ft x 10 ft form factor)
		241-480	3-rack TR (120 ft², 10 ft x 12 ft form factor)
		> 480	4-rack TR (140 ft², 14 ft x 10 ft form factor)

**Maximum quantity of active WAOs (the horizontal distribution cables that are patched to a switch port, actively supporting an end-user device) that can be operated in the TR (this aligns with the maximum quantity of 48-port switches that can be supported out of a TR of a given number of racks) in the supported serving zone.*

Ensure minimum clearance around racks and equipment:

- 3 ft distance clearance from the front, back, and one side of each rack row to TR walls. The fourth side must not abut a wall and needs to leave 12 in. clearance.
- Provide an additional 12 in. dedicated space on backboards to accommodate service provider, security, video, etc. equipment mounted on them.
- Provide an additional 30 in. wide by 36 in. front clearance required around electrical panel boards.

VA shall not design, build, or use "shallow rooms" or similar small spaces for TRs. Where existing shallow rooms are used for telecommunications cabling, they shall only be used for access to vertical chases and riser cabling pass-through installed there. No active or passive network equipment, power requirements, or environmental considerations are required.

There shall be a minimum of one standardized TR per floor. Generally, additional standard TRs should be provided:

- When the horizontal distribution distance to the work area exceeds 295 ft (90 m)
- Recommended when the horizontal distribution distance to the work area exceeds 262 ft (80 m)

IT, networking, and special telecommunications equipment from all facility users should be specified as 19 in. rack-mountable (or installed on 19 in. shelves) and installed in the network racks provided in the TR for this purpose. The installation of separate vendor-provided wall-mounted racks for this equipment is not authorized. Space on the backboard is reserved for systems that cannot be rack-mounted (e.g., enclosures for proprietary security system components, fire protection system enclosures).

See Appendix B:: OIT Design Guide Templates for additional design considerations.

4.1.4 Telecommunications Enclosures

These specifications define a standardized Telecommunications Enclosure (TE) for use in specific limited circumstances where a standard TR is not feasible or warranted.

Evaluation Factors

- Number of WAO served
- Installation environment

Implementation Guidance

Space classification. Telecommunications Enclosures (TE) may be deployed to the following types of non-healthcare spaces (any space below may also be granted a variance to use a TR less than 80 ft² as long as the excepted clearance requirements are maintained and the maximum of 96 WAOs is not exceeded):

- Parking structures
- Technical spaces such as warehouses, kitchens, laundries, mechanical/electrical plant buildings, chiller or boiler plants, garages, and paint shops
- Historical quarters converted to administrative use
- Buildings with no or limited VA staffing presence and limited connectivity requirements such as gyms, auditoriums, chapels, etc.
- Temporary modular trailers (Temporary buildings and trailers must be validated to be actually temporary, with a planned date of removal and no history of previously deferred or canceled removal plans)
- NCA field facilities
- Fisher House buildings
- VHA mental health administration facilities (veterans centers)

See Section 4.4.17 Telecommunications Enclosure Layout Standards for selection criteria, saliant characteristics, and enclosure level implementation guidance.

4.1.5 Entrance Rooms

Entrance rooms are a subset of the NSC classification archetype with less stringent temperature range requirements. Entrance rooms have the additional requirement of matching the electrical distribution and heat rejection redundancy requirements of the computer room that they support.

Entrance rooms are the entrance to a building where both public and private network service cables and equipment (including wireless) interface with the data center cabling system. Usually this is the demarcation point where operational control or ownership changes, typically between the service provider and the customer.

In new construction, the entrance rooms require special consideration for earlier beneficial occupancy than other building functions. Plan completion of construction and outfitting of

entrance rooms to occur earlier in projects than for other telecommunications spaces. Entrance room outfitting must be complete by the time that carrier circuits and carrier equipment from service providers are brought onto campus, allowing other systems to be tested and commissioned.

Entrance rooms will have similar features as TRs including backboard, racks, power, and cable management. DCIE shall design or conduct design reviews of all projects involving new or renovated entrance rooms to assure that the power, cooling, and room layout are consistent with VA and industry standards.

Entrance rooms shall be a minimum of 80 ft² for a one-rack entrance room and an additional 20 ft² for each additional rack required.

Two entrance rooms are required for each VA campus supported by a CDC or CSC. These are typically located in the same building as the computer room serving the campus. Where two entrance rooms are required to support the diverse providers (for CDCs and CSCs), they must be located at least 66 ft (20 m) apart.
On smaller VA campuses (including stand-alone buildings) supported by a single telecommunications space, the entrance room can be collocated in that space.

Additional buildings on the campus will not have entrance rooms. Cable plant media is routed directly from the campus data center to each TR in each additional building on campus. VA does not use building distributors, which would be individual entrance rooms for buildings and would be, in effect, intermediate cross-connects for the cable plant media.

Entrance points must be within 50 ft (15 m) of the OSP entrance point duct bank to allow for transition from OSP to ISP cabling.

Health care facility entrance rooms shall be a minimum of 170 ft². If more than four racks are required than an additional 20 ft² per additional rack must be added to the design.

Evaluation Factors

Number of telecommunications providers

Implementation Guidance

A TR or equipment room (computer room) may serve as an entrance room.

Develop diverse building entrance routes when more than one access provider serves a building so a catastrophic failure along one entrance route will not interrupt the entirety of a building's telecommunications service.

See Appendix B: for additional design considerations.

4.1.6 Antenna Entrance Rooms

Antenna entrance rooms are a subset of the NSC classification archetype (and entrance room function) with less stringent temperature range requirements. Antenna entrance rooms are the telecommunications entrance room for roof-mounted antenna, microwave, satellite dish, and

other telecommunications services mounted at the roof level. They accommodate all provided and planned Radio Frequency (RF) based systems and headend equipment cabinets housing cellular reinforcement Distributed Antenna System (DAS), Master Antenna Television (MATV), Television Receive Only Master Antenna Satellite Television (TVRO), Very Small Aperture Terminal (VSAT), High Frequency (HF), microwave, Radio Entertainment Distribution (RED), Public Address (PA), Two-Way Radio, Radio Paging System (RPS), and Video Surveillance Systems (VSS) including Closed Circuit Television (CCTV), Security Surveillance Television (SSTV), etc. This room will have the same TIA-942 rating as lower entrance rooms, but will have additional power, racks, and bonding to support the associated carrier and radio equipment. Where feasible, all signal amplifiers, carrier equipment, cellular transceivers, etc. for intrabuilding DAS and public access cellular service should be installed in this entrance room.

Evaluation Factors

- Number of antennas
- Type and quantity of media
- Number of Service Providers
- Supported services

Implementation Guidance

- 300 ft² conditioned room with two rows of five telecommunications racks
- Redundant 5000 VA UPS systems to supply fully redundant backup power for a 5 kW load
- One PBB sized bonding busbar to support the room
- One SBB sized bonding busbar behind each rack to support carrier bonding
- A minimum of four trade size 5 (data center) with a minimum of two trade size 4 conduits
- Intrabuilding backbone conduits must be installed with a minimum of four in. extending AFF to prevent down flooding
- All penetrations are to be weatherproof
- All conduit to be outfitted with mechanical firestop protection (no clay or pillows)
- ESD flooring to be bonded to the main SBB in this room
- All racked equipment to be bonded to nearest busbar
- Basket-type cable tray around the perimeter to be bonded
- Ladder-type cable vertical wall-mounted tray to be bonded

4.2 Electrical Power and Grounding Standards

These specifications define a standardized power distribution from branch distribution panel equipment to the active IT equipment enclosure with sufficient power to energize up to 5 kW redundantly in a Standard Density (SD) configuration, or up to 10 kW redundantly in a High Density (HD) configuration. This approach allows the facility engineer to provide a standardized branch circuit (3-phase 60 A) through legacy facilities for the majority of server, LAN, and storage stacks. Proprietary and equipment-specific power requirements shall be avoided.

This standardized approach creates consistency throughout the data center and reduces overall power complexity. Ultimately, this approach will reduce the capital costs of installing new

equipment and the operation costs by reducing or eliminating the need to change branch circuits with each IT equipment refresh. The Minimum Circuit Ampacity (MCA) in IT support spaces, for both critical and convenience distribution, is 20 A. All circuits supporting IT support spaces shall be sized (breaker, conductor, and receptacle equipment) at 20 A or larger.

Electrical distribution in the data center shall be redundant on diverse paths and follow rectilinear pathways when not contained in a cable tray.

Headends for A/B electrical paths to distribution devices (busway headends, PDUs, etc.) follow different paths for physical path redundancy.

Why did the Electrical Power and Grounding Standards change?
The previous standards for power distribution specified 30 A 3-phase distribution deployed through a 30 A redundant zPDU. This topology was only consistent with legacy facility distribution and did not address sustainable electrical distribution design using busways. In addition, the 30 A circuit can only provide 8.6 kW, which limited the 5 kW standard design's actual consumption to 4.3 kW; while loading design factors typically keep an enclosure with 5 kW (rated) load operating at not more than 70 % (3.5 kW) and within the allotted power budget. Providing the full design 5 kW of power capacity at the enclosure was deemed to be more conservative while remaining within the ability of most existing VA facilities to reject the heat generated.

4.2.1 Topology for Power Distribution Standards

Power distribution topologies in IT support spaces are dependent upon the:

- Classification archetype of the facility or IT support space
- Planned or in-use type of power distribution system, and
- Planned density of the IT equipment cabinets to be supported

Different topologies are used in data center archetype telecommunications spaces (CDCs, CSCs, and MSCs) than in distribution archetype telecommunications spaces (NSCs, entrance rooms, antenna entrance rooms, and TRs).

Active equipment installed in the VA telecommunications environment shall minimally be configured with dual-redundant Power Supply Units (PSU), excepting carrier equipment placed in entrance rooms and antenna entrance rooms. PSUs shall be rated for 208 V input and configured to operate in shared load mode rather than redundant mode to balance A/B power under normal operating conditions.

Power distribution topologies for IT equipment are 2N redundant at the IT equipment enclosure level. Where active equipment is not supplied with dual-redundant PSUs, it shall be provided with a micro-automatic transfer switch matching the power distribution system.

Deviations from the power distribution standards require an approved written variance from DCIE.

4.2.1.1 Topology for Power Distribution (CDC, CSC, MSC)

Topologies employed are dependent upon the type of branch power deployed to IT equipment enclosures. There are two types in use:

- In new construction and in renovations where there is sufficient vertical height, electrical track busway distribution is used
- In legacy facilities without adequate ceiling height, underfloor or cable-tray whips are used

For general purpose equipment enclosure load planning, utilize 50 % of the sum of the IT equipment power supply units on one distribution leg (either the A-side or B-side) to calculate the total power load for the set of equipment. In aggregate, this provides a sufficiently conservative maximum power requirement for equipment in the enclosure.

- Topologies employed are dependent on the designed density of IT equipment to be supported. There are two power density classifications: Standard and High as depicted in Figure 3 below.

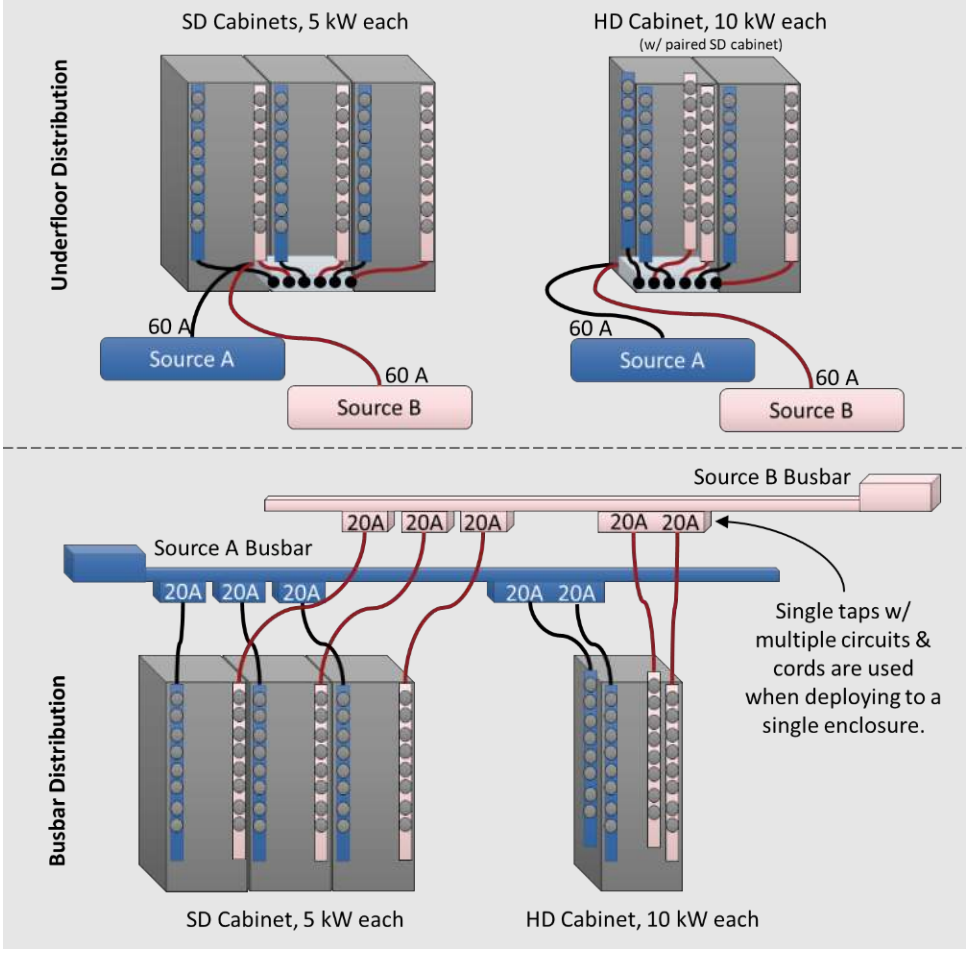

Figure 3: Power Distribution Options- Simplified Visualization (CDC, CSC, MSC)

For general IT support space purposes IT equipment cabinets will be SD, utilizing legacy underfloor/whip distribution.

Note: Insertion of HD cabinets requires specific design work by DCIE and will not be accomplished ad-hoc without approved, validated designs including CFD models showing acceptable thermal conditions of the overall design at ultimate operating load, in contingency conditions.

Power is limited to 5 kW in SD cabinets. Topology detail for this type of distribution is shown in Figure 4 and Figure 5 below. Design and install equipment load not to exceed this power and heat density without design approval and validation from DCIE.

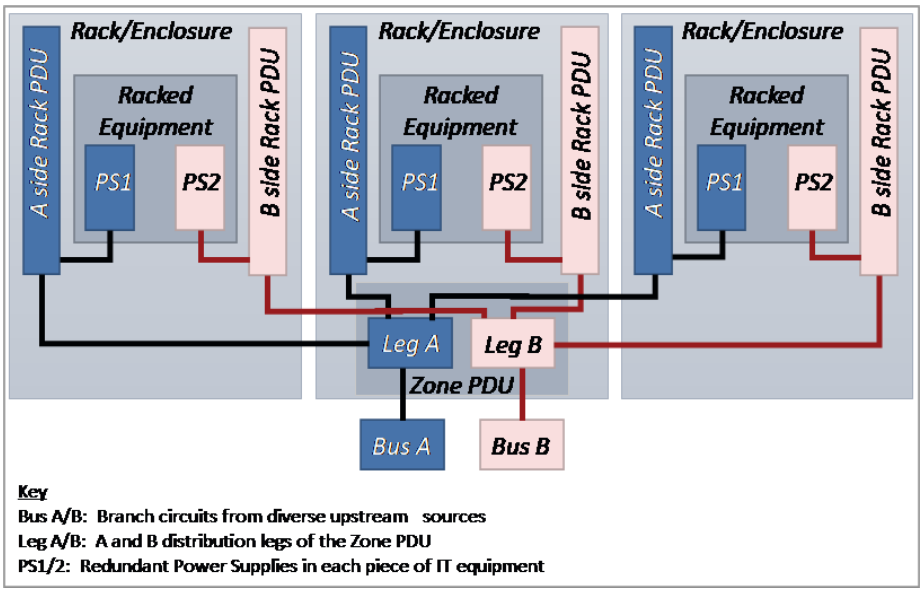

Figure 4: Standard Density Underfloor/Whip Distribution Topology (CDC, CSC, MSC) — 60 A Zone PDU

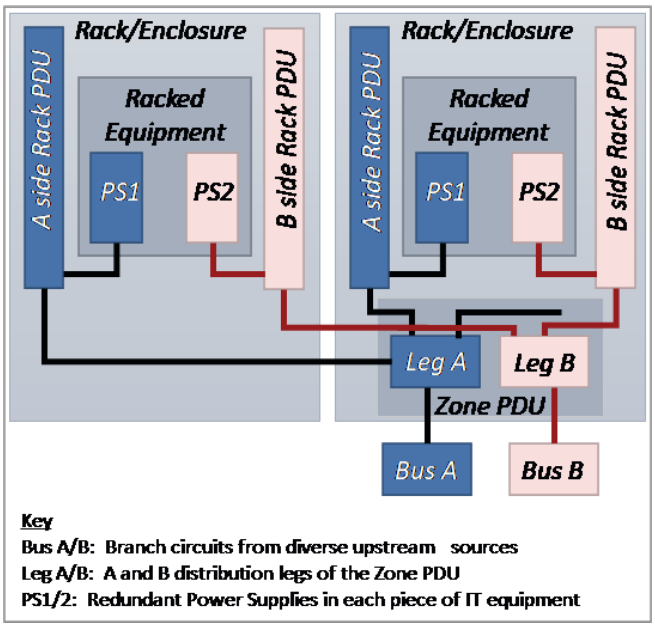

Figure 5: Standard Density Underfloor/Whip Distribution Topology (CDC, CSC, MSC) – 30 A Zone PDU

Note: Only DCIE is authorized to approve installations exceeding the SD level. HD cabinets may be possible in some facilities if heat rejection systems are properly designed and operated. HD power density is limited to 10 kW. Topology detail for this type of distribution is shown in Figure 6 *and* Figure 7 *below:*

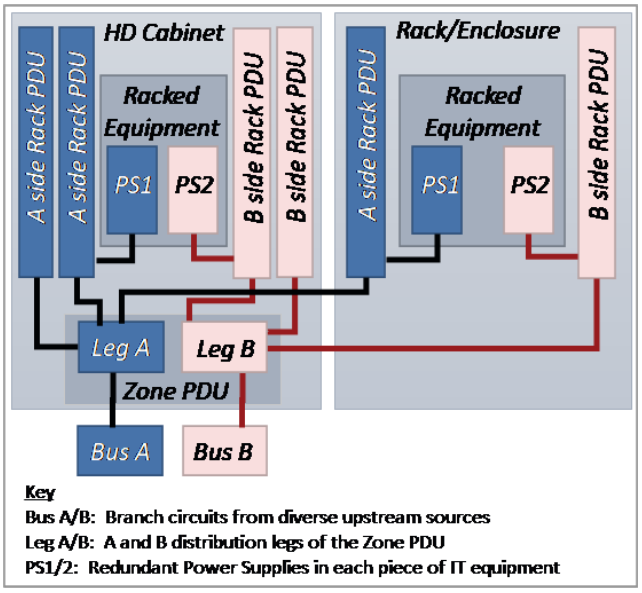

Figure 6: High Density Underfloor/Whip Distribution Topology (CDC, CSC, MSC) – 60 A Zone PDU

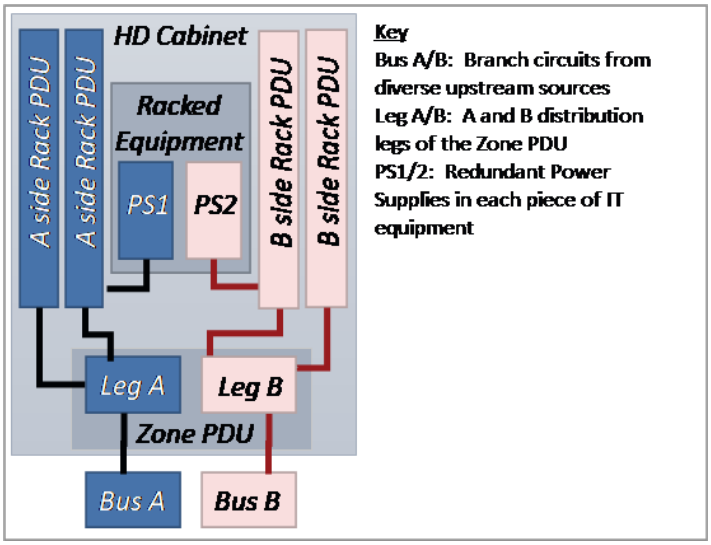

Figure 7: High Density Underfloor/Whip Distribution Topology (CDC, CSC, MSC) – 30 A Zone PDU

4.2.1.2 Topology for Power Distribution (NSC, TR, Entrance Room)

For general purpose equipment enclosure load planning in distribution spaces, utilize 75 % of the sum of the IT equipment power supply units on one distribution leg (either the A- or B-side) to calculate the total power load for the set of equipment. In aggregate, this provides a

sufficiently conservative maximum power requirement for Power-over-Ethernet (PoE) distribution switches in the enclosure.

For distribution telecommunications space purposes IT equipment enclosures will be SD, utilizing legacy whip distribution. High density enclosures are not utilized in these classifications of telecommunications spaces. Power density is limited to 5 kW per enclosure. Topology detail for this type of distribution is shown in Figure 8, Figure 9, and Figure 10 below. Only one distribution leg is required to be supported by UPS in these classification archetypes. If only a single distribution bus is powered by generator (emergency power), the UPS shall be on the same distribution leg to ensure battery recharge during generator operation.

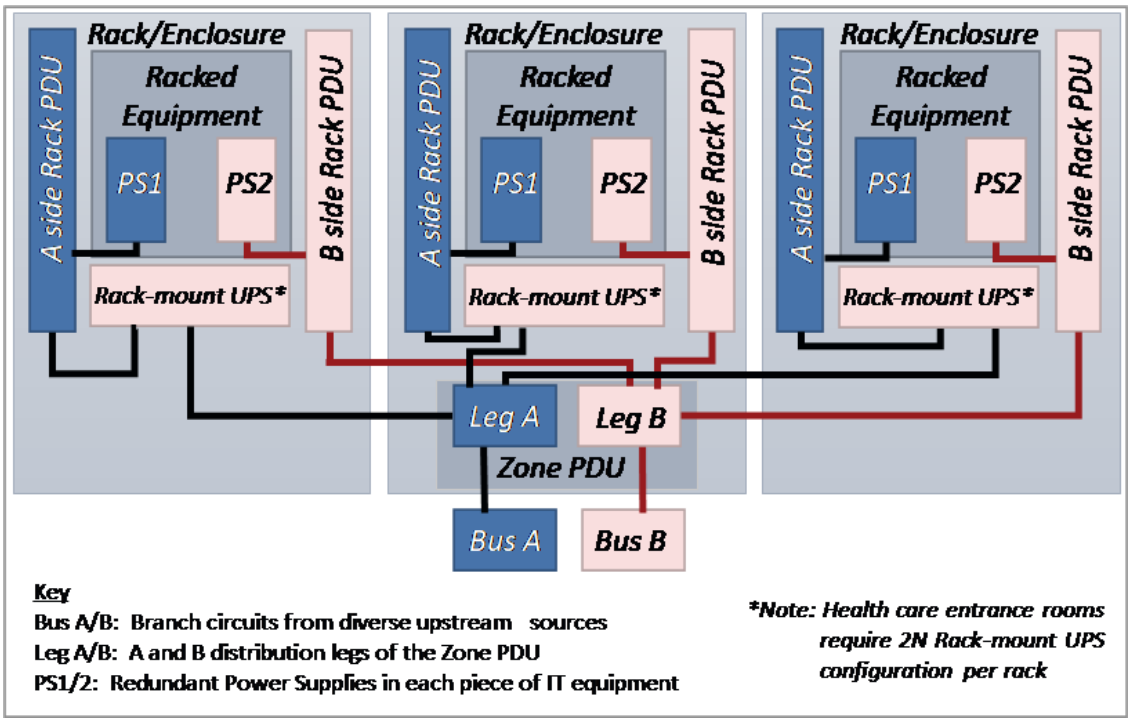

Figure 8: Whip Distribution Topology with In-Rack UPS (NSC, TR, Entrance Room) – 60 A Zone PDU

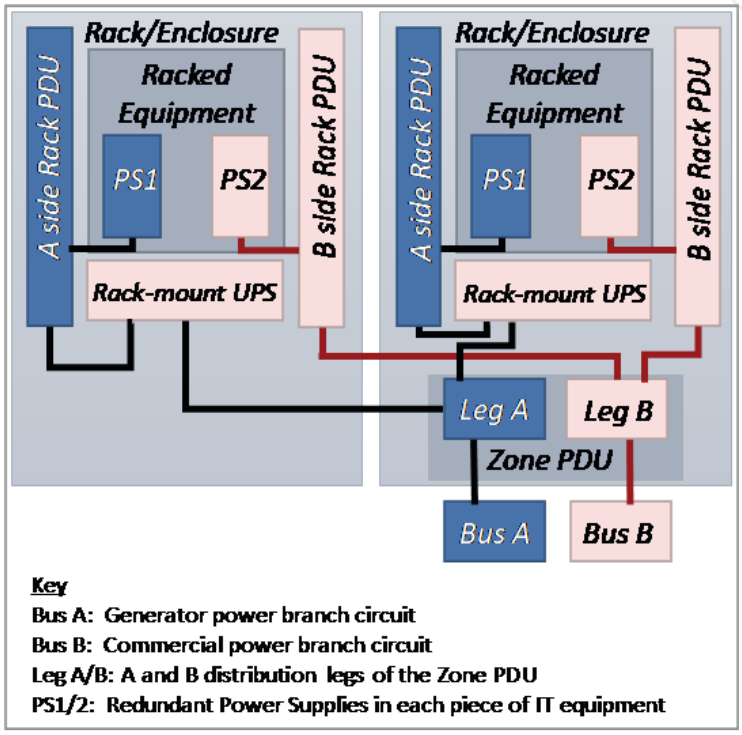

Figure 9: Whip Distribution Topology with In-Rack UPS (NSC, TR, Entrance Room) — 30 A Zone PDU

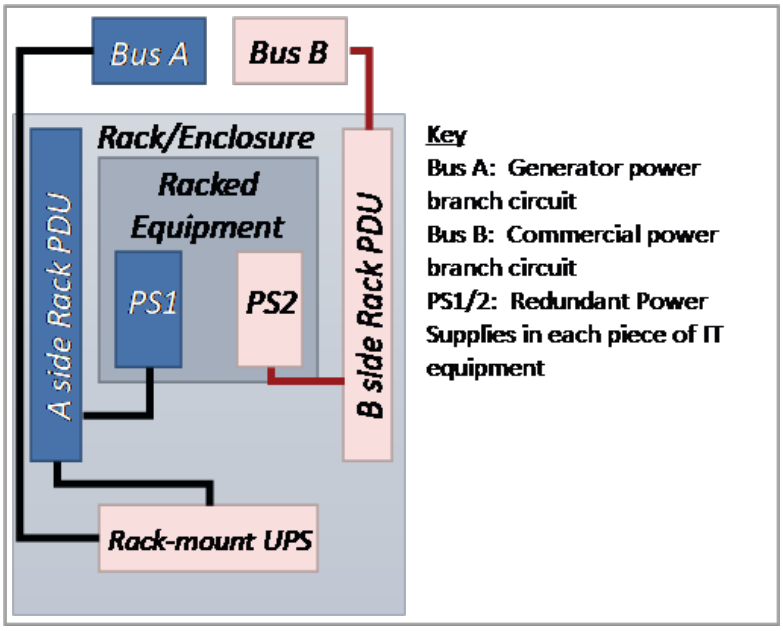

Figure 10: Single Rack Whip Distribution Topology with In-Rack UPS (NSC, TR, Entrance Room) — 20 A Circuits

4.2.2 Uninterruptible Power Supply Specifications

These specifications define the high-level technical requirements for Uninterruptible Power Supply (UPS) systems that support VA enterprise data centers and related IT spaces. This standard shall be used to quantify and qualify designs of UPS systems and the necessary physical infrastructure supporting data center facilities and spaces when those spaces are being designed, built, retrofitted, refreshed, and updated.

Facility UPS systems shall have a planned design load which covers 100 % of the ultimate IT equipment electrical load design in the data center sized to provide 10 min of backup capacity.

Table 11: Data Center Uninterruptible Power Supply Specifications

ID	Primary Attribute	Secondary Attribute	Specification
1	Technology	Inverter Preferred	UPS systems at CDCs, CSCs, and MSCs shall be inverter preferred systems, such that the power distribution path is through the inverter whether on commercial or stored power
		Double Conversion	Double conversion systems are acceptable for use as inverter preferred technologies
		Delta Conversion	Delta conversion systems are acceptable for use as inverter preferred technologies
		Line Interactive	Line interactive UPS systems (typically rack-mounted systems up to 5-kVA capacity) are specified for use in TEs
		Standby/Offline	Standby/offline UPS technologies (commonly used for desktop computer applications) are prohibited in VA data center applications
2	Design Configuration and Capacity	Serial UPS Systems	• Serial (or cascaded) UPS systems are prohibited in VA environments • Under no circumstance shall a UPS system be on a circuit supported by a separate UPS system • For the purposes of this specification, any infrastructure system that uses stored battery energy as its backup is considered a UPS system (this includes server and storage IT equipment configured with external battery backup systems)
		Planned Design Load	Each "N" need on a facility UPS system shall have planned design load covering 100 % of the IT equipment loading planned for the facility

ID	Primary Attribute	Secondary Attribute	Specification
		Modularity	• Modular frame UPS systems with smaller, more granular UPS and battery modules are preferred over monolithic systems • Populate UPS and battery modules based on actual critical load requirements, not on ultimate design load conditions or frame capacity • Maintain internal N+1 capabilities on installed UPS and battery modules
		Upstream Sources	• UPS systems serving a computer room critical load shall be powered from a generator-backed source, where feasible • 2N UPS systems shall be powered from different sources to mitigate single points of failure • Ideally, 2N systems should have both systems powered from different busses with each powered from the critical branch • Where multiple busses on the critical branch do not exist, 2N UPS systems should have one system powered from the critical branch and the other system powered from the equipment branch
		Appropriate Loads	• Only IT data processing equipment, peripherals, and communications equipment are authorized to be powered by the data center UPS • Do not place administrative loads or mechanical equipment loads on UPS power
3	Energy Storage System	Battery Types	Valve Regulated Lead Acid (VRLA) battery systems for system designs less than 400 kVA
		Battery Sizing	Sized to maintain the UPS system full load rating for 10 min
		Maintenance Determination	• VRLA batteries shall only be installed in locations where preventative maintenance is readily accessible and effective • Notify DCIE during project planning

ID	Primary Attribute	Secondary Attribute	Specification
		Kinetic Energy Systems	• Rotary (flywheel) UPS systems require detailed, consistent maintenance that must be taken into consideration if they are to be considered for any installation • Do not install kinetic energy systems unless these maintenance requirements can be met without risk or constraints • Notify DCIE during initial project planning
4	Environmental and Monitoring System	Battery Monitoring System (BMS)	• Dedicated BMS equipment shall be installed on all battery strings on UPS systems with design capacities of 40 kVA and greater • BMS systems shall not be powered by the UPS batteries being monitored
		Monitoring System Technology	• BMS shall use a pulsed AC impedance measuring method that does not discharge the batteries during the measurement cycle • AC ripple impedance testing methods and discharge testing below cell open circuit voltages are not acceptable methods
		Battery Environment	Optimal battery life when maintained at 77 °F
		Spill Control	Required for installations using Vented Lead Acid (VLA) batteries
		Ventilation	Room monitoring and automatic ventilation is required for installations using VRLA and VLA batteries

Evaluation Factors

- UPS Technology
- Energy Storage Technology
- Battery System Environment
- BMS

Implementation Guidance

UPS systems supporting VA data center facilities shall be designed and operated in accordance with the guidance provided in this standard.

Li-ion battery systems for VA data centers are not currently authorized. They offer size, power, and weight advantages over Valve Regulated Lead Acid (VRLA) and Vented Lead Acid (VLA)

batteries, but without full consideration of the risks of their operation for this purpose in the VA Fire Protection Design Manual (FPDM), HVAC Design Manual (HVAC DM), and Electrical Design Manuals (EDM), they may not be specified or installed.

Cascaded UPS Systems are expressly forbidden IAW 4.2.2.1.

4.2.2.1 Cascaded UPS Systems

Use of any UPS or additional battery-backed system downstream to the primary (critical bus) UPS is not an Underwriters Laboratories (UL) listed application and is prohibited by VA standards. This may jeopardize the fault clearing capability of engineered breaker coordination and introduces an additional point of failure and unnecessary load to the primary UPS thus degrading overall data center power reliability.

A downstream (cascaded) UPS is assumed to recognize the upstream (main) UPS sine wave. If the downstream UPS does not recognize the upstream UPS sine wave, the downstream UPS (when it switches on) may never synchronize back to the upstream UPS output waveform. If that should occur, the downstream UPS would stay on battery until the battery failed, then shut off.

The National Electrical Code® (NEC®) requires the ability to disconnect all electronic equipment and HVAC systems in case of fire or other emergency. In general, emergency disconnect systems are present in most VA enterprise data centers. If cascaded UPS systems are installed, the Emergency Power Off (EPO) will not de-energize the entire data center as the EPO will not be able to turn off the downstream UPS. This creates a danger to fire and rescue workers in an emergency.

4.2.2.2 Battery Monitoring

When a power outage occurs, the first system to engage and provide back-up power is the UPS, which draws from batteries until a generator can take the full load. Maintenance of these batteries and knowing how long they can be expected to continue to provide effective service is a critical link in the redundant electrical supply system. Battery Monitoring Systems (BMS) for room- and higher-level UPS equipment shall be installed and maintained for each battery string.

Rack-mounted UPS equipment requires a network interface card for connection and monitoring by the central Building Automation System (BAS) and set for alarming on certain battery conditions.

Modular UPS systems specified for room- and higher-level support functions typically have internal BMS components, and as such are exempted from the specifications below. Modular UPS systems, including battery systems, shall be connected, and monitored by the BAS.

Other (monolithic) UPS systems have separate battery strings, either cabinet- or rack-based depending on the battery technology in use. Battery strings for these UPS systems shall be connected and monitored by the BAS, and meet the following minimum requirements:

- System shall meet all current Institute of Electrical and Electronics Engineers (IEEE) recommendations for battery monitoring. System shall not be powered by the UPS batteries being monitored.
- Minimum battery parameters measured shall include cell and inter-cell impedance; system voltage; float, charge and discharge currents; and cell/ambient temperatures. Impedance measurement specification shall be to 0.1 ± 0.01 milliohms (mΩ).
- System shall use a pulsed AC impedance measuring method that does not discharge the batteries during the measurement cycle. AC ripple impedance testing methods are not acceptable. Discharge testing below cell open circuit voltages is not an acceptable method.
- System shall allow individual cell replacement without disconnection and removal of the wiring harness to reduce replacement and maintenance time per cell.
- System shall use measured baseline and follow-on information for individual cells for alarm and trend analysis. Jar-level and multi-cell testing are not acceptable. Discharge data logging as well as charge and float logging shall be enabled.
- System shall be programmable to set custom test and out-of-limit alarms. System shall be integrable with third-party Building Automation Systems (BAS).
- System shall have trending, graphing, and reporting software. The software shall analyze voltage, impedance, and temperature measurements, allowing the predictability of battery performance. Software shall acquire and archive measurements and trending information for off-line presentation in report and graphical format. Software shall archive and display power outage events, their duration, decaying voltage data (if the power outage was long enough), and current out on discharge.
- System software shall be capable of being controlled remotely using Building Automation and Control Networking Protocol (BACnet), Modbus, Controller Area Network Bus (CANbus), or Fieldbus via ethernet or modem to view and modify settings and limits, acquire data and alarms, reset alarms, and perform on-line diagnosis. Software shall be capable of alarming via BAS, Simple Network Management Protocol (SNMP), email, and phone notification.
- Software shall automatically gather measurement units on a user-determined schedule for trending database construction.

Preventative maintenance services on battery monitoring systems shall be outsourced to a qualified service provider and shall include all consumable parts, remedial repairs, labor, and expenses. The service provider shall provide not less than annual maintenance services.

4.2.3 Transformers

Transformers supporting power distribution for critical loads in Rating 3 facilities (CDCs, CSCs, and some MSCs) shall be minimum K-13 rated for harmonics reduction. This includes transformers located downstream of UPS equipment supporting all critical load distribution panels, including in PDUs. No harmonics reduction is required for transformers supporting Rating 2 MSCs, NSCs, and other IT support spaces.

4.2.4 Branch Power Circuit to Rack/Cabinet

This section describes the power circuit characteristics from branch distribution panel equipment to the active IT equipment enclosure distribution equipment.

Table 12: Branch Power Circuit to Rack/Cabinet Standards (Underfloor/Whip Distribution)

ID	Primary Attribute	Secondary Attribute	Specification
1	Branch Circuit (underfloor/whip distribution)	Voltage	120/208 V
		Phase	3-phase WYE
		Amp	30 A or 60 A
		Neutral Conductor	One gauge larger than the phase conductors
		Receptacle	• L21-30R for 30 A zone PDUs (zPDU) • 5-wire cable hardwired junction enclosures (no receptacle) for 60 A zPDU • L21-20R may be used in legacy single-rack TRs to directly feed rack Power Distribution Units (rPDU)
		Whip Color	Differentiated by source bus (jacket or other marking)
		Whip Pathway (underfloor)	Rectilinear with respect to the equipment aisles with no diagonal runs
		Whip Length	Following rectilinear path and no longer than 4 ft of slack

Table 13: Branch Power Circuit to Rack/Cabinet Standards (Busway Distribution)

ID	Primary Attribute	Secondary Attribute	Specification
1	Branch Circuit (Busway Distribution)	Amperage	Size selected based on full load anticipated for all enclosures plus 30 % phase imbalance allowance
		Orientation	• Diverse supply pathways to busway headends • Headends for source A at one end of the row and headend for source B at opposite end • Busways oriented and tap enclosures installed to maximize serviceability
		Busbar Headend	• Amp metering • Network monitoring (RJ-45) reporting
		Tap Circuit Amperage	• 20 A • Multiple circuits on same tap enclosure acceptable
		Tap Whip	• Strain relief at exit from tap enclosure • L21-20 connector
		Tap Whip Neutral Conductor	One gauge larger
		Tap Whip Color	Differentiated by source bus (jacket or other marking)

Evaluation Factors

- Headend metering for aggregation at the row level
- Amperage
- Neutral conductor gauge

Implementation Guidance

A test plan is required to ensure that each bus is properly represented in a rack or cabinet upstream through each entire distribution path.

4.2.5 Zone Power Distribution Units

This section describes the characteristics of the zone Power Distribution Unit (zPDU) used in underfloor/whip distribution topologies. The zPDU allows the implementation engineer to specify a standard branch circuit to support a pair of SD, 5 kW redundant and single HD, 10 kW redundant enclosure power configurations.

Zone Power Distribution Units reduce the number of branch circuits (whips) that need be installed to support power distribution to IT equipment enclosures, reducing requirements for circuit breaker spaces and facility power distribution panels. Their use also reduces electrical circuit material and installation labor. Where these are not constraints and the cost of deploying individual L21-20 circuits to each IT equipment enclosure is lower than their use, their use is not mandatory.

Table 14: Zone Power Distribution Unit Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	60 A Zone zPDU	Mounting	Standard 19-in. rack mount
		Agency Approval	• UL Listed • UL Listed 60950 • UL Recognized Component Mark
		Form Factor	2 Rack Units (RU)
		AC Voltage Input	120/208 V WYE (3-phase)
		Current Input	60 A
		Current Output	20 A
		Full Load	• 43,200 W (21,600 W redundant) • 60 A (3-phase)
		Hardwired Junction Enclosures (Input)	Two 60 A 5-wire DIN copper terminal blocks, accommodating 4 American Wire Gauge (AWG) input conductors
		National Electrical Manufacturers Association (NEMA) Outlets for Vertical rPDUs (Output)	Six L21-20R
		Cord Length	10 ft
		Breaker Groups	• 60 A A-side and B-side (input) • 20 A secondary (branch) A-side and B-side (output)
2	30 A Zone zPDU	Mounting	Standard 19-inch rack mount
		Agency Approval	• UL Listed • UL Listed 60950 • UL Recognized Component Mark
		Form Factor	2 RU
		AC Voltage Input	120/208 V WYE (3-phase)
		Current Input	30 A

ID	Primary Attribute	Secondary Attribute	Specification
		Current Output	20 A
		Full Load	21,600 W (10,800 W redundant)
		Input	Two L21-30P
		Output NEMA Outlets for Vertical rPDUs	Four L21-20R
		Output NEMA Convenience Outlets	Six 5-20R
		Cord Length	10 ft
		Breaker Groups	• 30 A both A-side and B-side (input) • 20 A secondary (branch) A-side and B-side (output)

Evaluation Factors

- Power efficiency to reduce electricity losses for lowest overall lifecycle cost
- Number and type of receptacles provided

Implementation Guidance

One 60 A zPDU for each set of three SD racks or cabinets. Alternatively, one 30 A zPDU for each set of two SD racks or cabinets.

One 60 A zPDU for each set of one HD cabinet and one SD rack or cabinet. Alternatively, one 30 A zPDU for each HD cabinet.

Zone PDUs shall be mounted starting in RU1 at the bottom of the rack/cabinet due to excess weight to ensure stability, or immediately above the rack mounted UPS (if provided).

The correct specification for the zPDU is to feed it with two power sources. Power inputs should originate from two independent power sources. Each input will use identical specs: WYE (5-wire) configured, 208 V, 60 A, three-phase, terminating in vendor-provided junction boxes with terminal blocks for hardwiring conductors. The neutral conductor should be upsized one gauge to match the upsized neutral conductors in the PDU units. The neutral "upsizing" should ideally be continued in the power distribution system back to the UPS or transformer winding pole to increase the efficiency of the power distribution system and suppress harmonics in the system.

4.2.6 Rack Mounted Uninterruptible Power Supplies

This section describes the UPS systems that are mounted in racks located in NSCs, TRs, and entrance rooms where no facility UPS is available. The rack mounted UPS will provide 5 kW to 6 kW to the vertical PDU on the A-side distribution leg, supporting the SD, 5 kW design. Install

the rack mounted UPS between the zPDU and the rPDU on the A-side distribution, or between the 20 A branch circuit and the rPDU (in legacy single-rack TRs).

Rack mounted UPS systems are not utilized in the CDC, CSC, or MSC classification archetypes.

Table 15: Rack Mounted Uninterruptible Power Supply Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	UPS (in rack/ enclosure)	Mounting	19 in. rack mount
		AC Voltage Input	208 V 3-phase
		Current Input	20 A
		Current Output	20 A
		Output Receptacle	L21-20R
		Input Plug	L21-20P
		Phase Type	Three-phase
		Connectivity	Network interface card required for connection and monitoring by the BAS and set for alarming on certain battery conditions
		Battery Capacity	Sufficient capacity to provide minimum 10 min runtime at current full loading levels
		kW Rating	5 kW to 6 kW

Evaluation Factors

- Battery Capacity
- kW Rating
- Not cascaded (no upstream UPS feeding another UPS)

Implementation Guidance

Rack mounted UPS shall be mounted starting in RU1 at the bottom of the rack due to excess weight to ensure stability.

Health care center entrance rooms have two UPS systems, one on the A-side and one on the B-side.

4.2.7 Vertical Rack Power Distribution Units

This section describes the vertical Rack PDUs (rPDU) (power strips) that will energize IT equipment in racks and cabinets.

Each SD rack or cabinet will receive two vertical rPDUs, one each for the A-side and B-side distribution legs. Each HD rack or cabinet will receive four vertical rPDUs, two each for the A-side and B-side distribution legs.

Table 16: Vertical Rack Power Distribution Unit Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	rPDU (in rack/ enclosure)	Mounting	Zero RU, toolless
		Receptacle Type(s)	• C-19 • C-13
		Receptacle Quantity	• C-19 (6 Minimum) • C-13 (30 Minimum) • NEMA 5-20 (4 Maximum) – TRs and entrance rooms only
		Power Cord Plug	L21-20P
		kW Rating	5 kW to 6 kW
		Input Voltage Rating	208 V
		Phase Type	Three-phase
		Output Voltage	120/208 V
		Monitoring	Power utilization per phase. Light Emitting Diode (LED) display and SNMP v3.0 with Secure Sockets Layer (SSL) Encryption

Evaluation Factors

- Type of receptacles provided
- Voltage delivered (208 V)

Implementation Guidance

Mount A-side rPDU on the left side of the enclosure, and B-side rPDU on the right side of the enclosure, as viewed from the back of the enclosure.

Rack PDU models with a limited quantity of additional NEMA 5-20 outlets may be required in TRs and entrance rooms and are authorized in lieu of the standard computer room model. They

must still meet the salient characteristics of the standard rPDU, particularly the input type (L21-20P) and outlet type and quantity (C13/C19).

A test plan is required to ensure that each bus is properly represented in a rack or cabinet upstream through each entire distribution path.

4.2.8 IT Equipment Power Cords

This section describes the equipment power cords that energize IT equipment in racks and cabinets.

208 V IEC 60320 power cords connect the rPDUs to the power supplies in the active IT equipment. Each typical piece of active IT equipment will receive two power cords, one each for the A-side and B-side distribution legs. As viewed from the back of the enclosure, the A-side power cord will route from the A-side rPDU on the left side of the enclosure, and B-side power cord from the B-side rPDU on the right side of the enclosure.

Figure 11: International Electrotechnical Commission (IEC) Standard C13/14 Cord Set

Table 17: IT Equipment Power Cord Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Equipment Power Cord	Color Code	• A-side: Black • B-side: A distinctly different color (white or gray preferred) • Differentiated by source bus (jacket or other marking)
		Securement	Locking configuration to match rPDU
		International Electrotechnical Commission (IEC) Standard 60320	• C13 at IT equipment power supply and C14 at Rack PDU (nominally "C13/C14") • C15 at IT equipment power supply and C14 at Rack PDU (nominally "C14/C15") • C19 at IT equipment power supply and C20 at Rack PDU (nominally "C19/C20")
		Voltage	UL-rated 208 V (minimum)
		Amperage	• 10 A (C13/14 and C14/C15) • 15/16 A (C19/C20)

Evaluation Factors:

- Connectors
- Power cord voltage
- Power cord color

Implementation Guidance:

Enterprise-class IT equipment power supplies are operable at 208 V. VA standards specify, and modern enterprise class IT equipment has, dual (A/B) redundant power supplies.

Equipment power cord connectors will be dependent upon actual equipment requirements.

Color coding of power cords is required to distinguish A and B sides for installation and troubleshooting.

Match power cord color scheme with upstream distribution color scheme where feasible. Use of colors reserved for other purposes (e.g., emergency bus distribution (red) or grounding (green) for alternate color is discouraged as these already have distinct meanings in electrical distribution.

All dual-corded IT equipment should connect to both A and B bus rPDUs for power redundancy.

Identify existing phase balancing on the rPDUs from the onboard meters. Determine which phase-grouping should receive the new equipment power cords to maintain or improve phase amperage balancing.

Install the A side (black) power cord from a rPDU on the left side of the rear of the enclosure to the corresponding IT equipment power supply.

Install the B side (white or other color) power cord from a rPDU on the right side of the rear of the enclosure to the corresponding IT equipment power supply.

Power cords should be installed into the same outlet and phase-grouping on both A and B rPDUs.

Provide IEC C13/14 (10 A) and IEC C19/20 (16 A) cord sets with all equipment requiring 16 A or less.

Except in authorized wall-mounted TEs, equipment power cords only rated for 125 V (e.g., with 5-15, L5-20, and similar plugs) shall not be ordered or installed on equipment to be installed in IT equipment enclosures without an approved variance from DCIE. Standard power distribution equipment does not support single-phase 120 V power distribution.

4.2.9 Bonding and Grounding

4.2.9.1 Bonding Practices in Telecommunications Spaces

All telecommunications spaces are to be bonded according to ANSI/TIA-607-D *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*, local codes, the VA Electrical Design Manual, National Electric Code, and National Electrical Safety Code. Typical VA telecommunications spaces utilize Alternating Current (AC) only. Variations to the guidance below may be necessary to accommodate Direct Current (DC) installations.

Grounding through the equipment power cord(s) does not meet the intent of ANSI/TIA-607-D. The guidance below is intended to ensure that the information technology equipment be provided a dedicated and specific ground path over and above the required AC power cord ground path. While the equipment typically has a power cord that contains a grounding/bonding wire, the integrity of this path to ground cannot be easily verified. Rather than relying on the power cord(s) grounding/bonding wire, equipment should be grounded in a verifiable dedicated manner as described in this overview.

Many types of equipment do not require individual bonding conductors and as such do not have an attachment point for bonding conductors. Equipment that does not have attachment points for bonding conductors may be bonded either through the equipment rail or the power cord. Refer to the manufacturer's documentation for guidelines.

LAN elements, such as switches and routers, have bonding to chassis requirements. These requirements should not be ignored.

Rack busbars are specified below to facilitate bonding for LAN equipment. Metallic pathways under 3 ft in length (e.g., wall and floor sleeves, J-hooks) are not required to be bonded.

All wall mounted and floor mounted racks, cabinets, and pathways exceeding 3 ft in length must be bonded to the busbar within the same telecommunications space.

Other equipment, such as ventilation systems and desktop equipment outside of the equipment room, are out-of-scope for this document but must be addressed per the manufacturer's requirements.

All exterior-mounted PoE or LAN-attached equipment, such as IP cameras, must be bonded to the telecommunications bonding infrastructure described below.

ESD floor coatings shall be bonded to the SBB in the same room.

4.2.9.2 Topology Overview

A Primary Bonding Busbar (PBB) (specifications below) will be located in a telecommunications entrance room and will be bonded to the Alternating Current Equipment Ground (ACEG) bus (when equipped) or the panelboard enclosure located in the electrical entrance facility via the telecommunications bonding conductor.

A Secondary Bonding Busbar (SBB) will be installed in each telecommunications space and will connect to the PBB via a Telecommunication Bonding Backbone (TBB). The SBB should be bonded to structural steel and the electrical panelboard ACEG bus when equipped within the telecommunications space.

Access flooring pedestals must be bonded per manufacturer specifications, AHJ and code requirements, and ANSI/TIA-607-D.Typically, a single PBB will be specified per building and one SBB will be specified for each telecommunications space.

Multiple SBBs are permitted to maintain optimal conductor routing.

All bonding conductors, including the TBB, will follow sizing requirements specified in ANSI/TIA-607-D.

Bonding conductors for telecommunications should not be placed in ferrous metallic conduit. If it is necessary to place bonding conductors in ferrous metallic conduit the conductors should be bonded to each end of the conduit using a grounding bushing or using a minimum sized conductor of 6 AWG at both ends of the conduit.

Busbars will be mounted with a 2 in. clearance between the rear of the busbar to the wall. The PBB and SBB will be mounted on listed insulators. Busbar location should be determined by the location of bonding conductors to maintain the shortest and straightest path. Typically, the SBB will be mounted directly in-line with the TBB.

Computer rooms will contain an SBB and, where an access floor is installed, a supplementary bonding grid is required under the raised floor to bond the pedestals.

The connection of the TBB to the SBB and connection of conductors for bonding telecommunications equipment and telecommunications pathways to the SBB will utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs. A Telecommunications Equipment Bonding Conductor (TEBC) will connect the racks and cabinets to the PBB/SBB. The TEBC will be a minimum of 6 AWG. Metallic objects will not serve as replacements for the TEBC; a continuous TEBC is required. The TEBC will be secured at no greater than 3 ft intervals. The TEBC should be minimum of 2 in. from other cable groups.

Bonding to the TEBC will utilize permanent compression-type fittings to create a permanent connection. Where no access flooring is used, the TEBC will be routed through cable trays. Cable trays will be installed with cable tray bonding conductors.

The TEBC will be connected to the cabinets/racks, to a Rack Bonding Conductor (RBC) or to a vertical/horizontal Rack Bonding Busbar (RBB). An RBC is a bonding conductor from the rack or RBB to the TEBC. Each cabinet or equipment rack will have a suitable connection point to which the bonding conductor can be terminated. Properly sized listed two-hole compression lugs or listed terminal blocks with two internal hex screw or equivalent torque characteristics shall be used at this connection point.

Resistance will be measured where practical between bonded elements, such as a cable tray or RBB, within a telecommunications space and the nearest PBB or SBB to confirm low-resistance continuity between that object and the busbar. Testing between an SBB and PBB should be conducted where practicable. Testing between the PBB and the Grounding Electrode should be conducted where practicable. Soil resistivity testing is beyond the scope of this document. Maximum resistance measurements for telecommunications spaces are:

- 5 Ω maximum, 3 Ω recommended for TRs
- 1 Ω recommended for data centers, entrance rooms, and antenna entrance rooms

The use of building steel can be a substitute for an intrabuilding Telecommunications Bonding Backbone if and only if:

- It is electrically continuous from the grounding busbar to the grounding electrode system
- It is bonded to the building grounding electrode system
- It passes a basic two-point continuity test showing resistance no higher than 5 Ω
- The metal in question is not concrete reinforcing steel. A TBB is recommended instead of using building steel because the later must be electrically continuous and bonded to the building's grounding electrode system

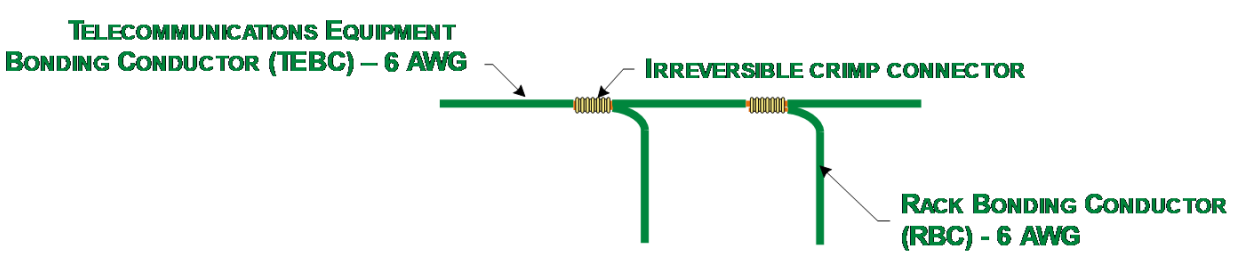

Figure 12: Typical Bonding Connection

Bends of bonding conductors terminating at the PBB or SBB will have a minimum inside bend radius of 8 inches or 90°. At other locations, bends in bonding conductors should be made with the greatest practical inside bend radius. A minimum bend radius of ten times the bonding conductor diameter is recommended. In all cases, a minimum included angle of 90° shall be used.

To limit the potential difference between telecommunications pathways or between telecommunications pathways and power pathways, all metallic telecommunications pathways

will be bonded to the RBB, PBB, or SBB. Cable tray sections will be bonded together via cable tray bonding conductors and will be bonded to the PBB or SBB.

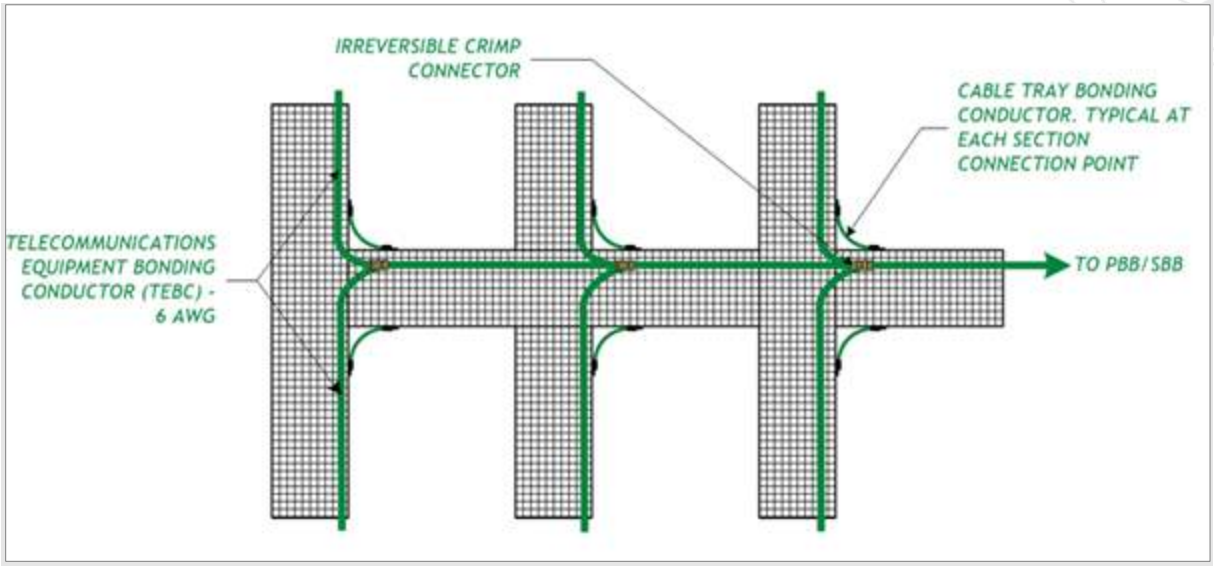

Figure 13: Typical Rack Bonding Layout

An RBB will be installed in the uppermost RU in telecommunications racks where LAN elements will be mounted. This document does not specify RBBs to be installed in server cabinets. The connection of the RBB or the TEBC to the rack will utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs. The unit bonding conductor should be connected to the RBB using a listed compression connector and to the grounding post of the telecommunications equipment if provided. The right side in the graphic below is the preferred style and mounting approach of the RBB. The left side in the graphic below will be used in server cabinets.

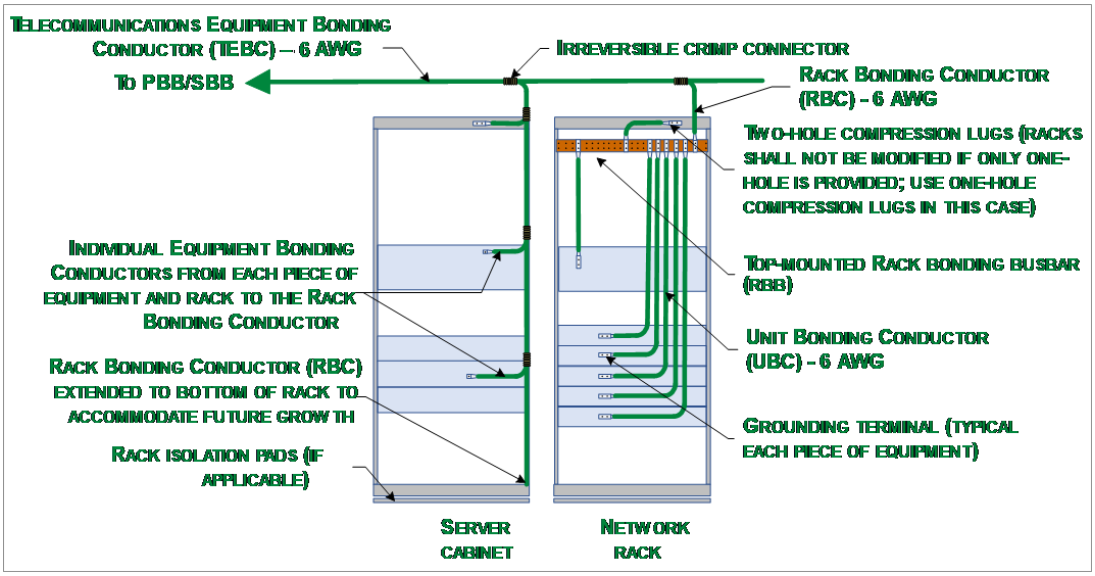

Figure 14: Typical Bonding Requirements for IT Equipment Enclosures

All racked equipment, such as LAN switching equipment, must be bonded if directed to do so by manufacturer's requirements. Never defeat the chassis bonding conductor or operate the equipment in the absence of a suitably installed bonding conductor. The ground wire from the electrical circuit energizing the device is not a replacement for chassis bonding. Racked LAN switches and other appliances requiring bonding will be bonded to the RBB located in the same rack. Each device will have a dedicated Unit Bonding Conductor (UBC) terminated with listed two-hole lugs. The UBC will not be shared or used as a bonding conductor for more than one device.

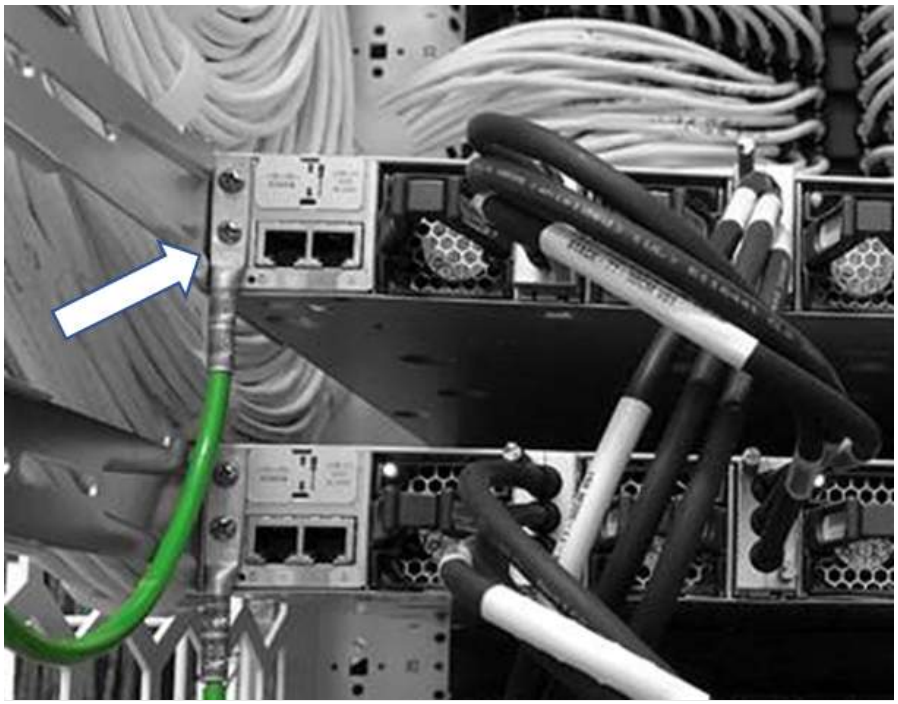

Figure 15: OEM Equipment Ground Lug Connection

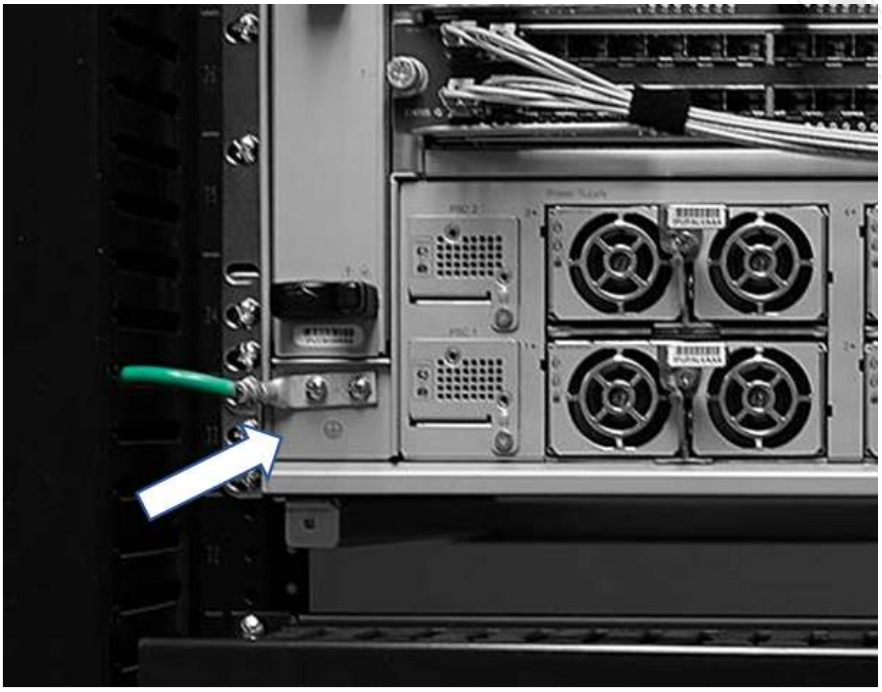

Figure 16: OEM Equipment Ground Connection

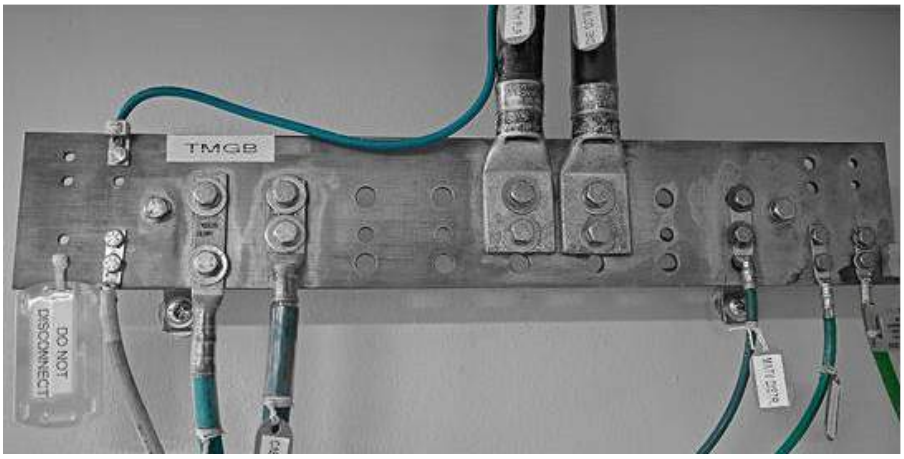

Figure 17: Primary Bonding Busbar

Table 18: Busbar Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Busbars	RBB, PBB, and SBB	• Provided with holes for use with correctly matched listed lugs and hardware • Copper, or copper alloys having a minimum of 95 % conductivity when annealed • As specified by the International Annealed Copper Standard (IACS) • Minimum dimensions of 0.25 in. thick x 4 in. wide and variable in length • Maximum 4.0 Ω to ground system resistance (from any point in the system, including IT equipment chassis) • Listed

Evaluation Factors

- Grounding system resistance
- All ancillary equipment, rack systems, cabinets/racks, backboards, etc. bonded to the bonding conductor
- Bonding conductor materials
- Bonding conductors installed using appropriate techniques
- Bonding connections provide low impedance path to ground (tight bolts, removal of non-conductive materials between metal-to-metal contacts)

Implementation Guidance

Connect PBBs to SBBs in other rooms as required.

Provide, inspect, and maintain in accordance with the VA Electrical Design Manual.

Remove powder-coated paint from racks, cabinets, ladder racks, etc. prior to installation to maximize the quality of grounding bonds.

Star-prong washers that bite into the metal may be used with caution that they must fully penetrate the paint for effective contact.

4.2.9.3 Building Earth Ground System

Note: The following sections are provided for reference only. Consult with VA Electrical Design Manual for design requirements.

A Building Earth Ground System (EGS) is required on all VA buildings regardless of the type, classification, or ANSI/TIA-942-B Rating of IT support spaces operating in those facilities.

Table 19: Building Earth Ground System Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Building Earth Ground System	NFPA 70 Article 250 compliant system	Required in all facilities
		Resistance Between Bonded Objects and SBB	4.0 Ω maximum

Evaluation Factors

Visual inspection of each telecom space for grounding system compliance required annually at a minimum.

Implementation Guidance

Provide, inspect, and maintain a facility EGS that meets the guidelines of NFPA 70 (National Electric Code) Article 250, Grounding and Bonding, and the VA Electrical Design Manual.

The building EGS should obtain a resistance-to-earth of 5 Ω or less as measured by the four-point fall-of-potential method according to IEEE 81.

4.2.9.4 Lightning Protection System

Note: The following sections are provided for reference only. Consult with VA Electrical Design Manual for design requirements.

A facility Lightning Protection System (LPS) is required on all VA buildings containing a Rating 3 computer room and recommended for all VA buildings regardless of the IT support spaces operating in those facilities. Included for reference only.

Table 20: Lightning Protection System

ID	Primary Attribute	Secondary Attribute	Specification
1	Lightning Protection System	CDC	NFPA 780-compliant LPS required
		CSC	NFPA 780-compliant LPS required
		MSC	NFPA 780-compliant LPS required for Rating 3 MSCs
		NSCs and Other IT Support Spaces	LPS recommended

Evaluation Factors

- Facilities containing Rating 3 computer rooms have NFPA 780-compliant LPS protecting the entire facility
- LPS terminals and roof-mounted equipment properly bonded

- Down conductors properly connected to earth ground system and tested for ground resistance triennially

Implementation Guidance

Where required and in accordance with the VA Electrical Design Manual, provide, inspect, and maintain a facility LPS that meets the guidelines of NFPA 780 (Standard for the Installation of Lightning Protection Systems).

4.2.10 Lighting

Lighting requirements in IT support spaces enable safe and reliable operation and maintenance of IT equipment and supporting infrastructure equipment. IT support spaces are intended to be lights-out operating environments except when access by operations and maintenance personnel.

ANSI/TIA-942-B recommends using LED lighting in IT support spaces to improve lifecycle cost. Managed Intelligent LED lighting in a data center can reduce server inlet temperatures by 2 °F to 3 °F. This can reduce cooling costs by up to 10 %.

Zoned and automated lighting systems meeting these requirements are acceptable.

Utilize energy-efficient motion sensors to activate lights in the immediate area soon after an employee enters an IT support space. All aisles and passageways shall be illuminated to allow for proper identification of visitors by security equipment and to allow for effective operation and maintenance of systems in the space.

Utilize a three-level lighting protocol in IT support spaces depending on human occupancy:

- Level 1: IT support space unoccupied - lighting should be sufficient to allow effective use of video surveillance equipment. Level 1 shall be provided in all IT support spaces.
- Level 2: Initial entry into the IT support space - motion sensors should be used to activate lights in the immediate area of entry and be programmed to illuminate aisles and passageways. Sufficient lighting should be provided to allow safe passage through the space and to permit identification via security cameras. Level 2 shall be provided in all IT support spaces.
- Level 3: Occupied space - when the IT support space is occupied for purposes of maintenance or interaction with equipment, lighting shall be 500 lux in the horizontal plane and 200 lux in the vertical plane, measured 3 ft above the finished floor in the middle of all aisles between cabinets. In IT support spaces larger than 2,500 ft^2, zone lighting shall provide Level 3 in the immediate area of work and Level 2 in all other zones. Level 3 is a requirement in all IT support spaces except for entrance rooms and TRs.

Lighting plan in IT support spaces should match the IT equipment layout. Attempt to place light fixtures in both cold and hot aisles so that technicians have sufficient illumination to work by. Lighting fixtures should be located above aisles between cabinets rather than directly above cabinets or overhead cable pathway systems.

Emergency lighting and signs shall be properly placed per Code and AHJ requirements such that an absence of primary lighting will not hamper emergency exit.

4.2.11 Metering

Metering is used to collect energy consumption data that can be used to track long-term trends, benchmark progress and performance, perform diagnostics, and alert data center operators to impending or ongoing system failures. The level of metering described is necessary for VA to:

- Baseline utility consumption
- Determine priorities for utility intensity reduction
- Measure the effectiveness of energy efficiency initiatives, and
- Show the use of power in telecommunications over time.

4.2.11.1 Metered Energy Consumption Data

All VA data center facilities shall install and operate an Automated Energy Metering system to meet the metered energy consumption data collection requirements of the metering and monitoring standards. This system may combine elements of Building Automation Systems (BAS), Data Center Infrastructure Management (DCIM) systems, Data Center Operations Systems, and others as needed to achieve the required outcomes.

All VA data center facilities shall report the following energy consumption data within the period specified:

Table 21: Metered Energy Consumption Data

Data	Units	Measured Location(s)	Period
Facility Total Electrical Consumption (FEC)	Kilowatt-hours (kWh)	Main building step-down transformer(s) and Generator plant	Monthly
Total Data Center Energy Consumption (TEC)	Kilowatt-hours (kWh)	Utility feed(s): Output to data center or Automatic Transfer Switch (ATS): Output to data center or Trunk circuit(s): Output to data center	Monthly
Total Data Center Physical Infrastructure Energy Consumption (TPIEC)	Kilowatt-hours (kWh)	Branch circuit(s) supporting physical infrastructure equipment: Output or Physical infrastructure equipment: Input	Monthly
Total IT Equipment Energy Consumption (TITEC)	Kilowatt-hours (kWh)	Rack-mounted PDU: Output or Power consumption data reported by IT system firmware: Input or Branch Circuit Monitoring (BCM) of circuit(s) supporting IT equipment: Output	Monthly

Data	Units	Measured Location(s)	Period
Total UPS Load Energy Consumption (TUPSC)	Kilowatt-hours (kWh)	UPS System(s): Output	Monthly
Total Renewable Energy Usage by Data Center (RENEW)	Kilowatt-hours (kWh)	Utility billing detail and/or Facility Engineering staff	Monthly

4.2.11.1.1 Facility Total Electrical Consumption

Facility Total Electrical Consumption (FEC) energy from the local utility is metered by the local utility provider. This portion of the metric can be obtained from the utility electrical bill or can be calculated if local resources have capabilities to read the electrical meter(s) directly.

Generator energy may be estimated by the number of hours that the generator plant(s) run times the power capacity of those generators. The time that the generators run includes building (live) load tests where the building (or some portion thereof) is supported by the generator plant but does not include offline generator tests and maintenance.

4.2.11.1.2 Total Data Center Energy Consumption

Total Data Center Energy Consumption (TEC) is the sum of Total Data Center Physical Infrastructure Energy Consumption (TPIEC) and Total IT Equipment Energy Consumption (TITEC).

4.2.11.1.3 Total Data Center Physical Infrastructure Energy Consumption

Total Data Center Physical Infrastructure Energy Consumption (TPIEC) includes the amount of energy needed to operate power supply/distribution equipment (transformers, switchgear, meters, UPS systems and PDUs, wiring to the IT devices), heating/cooling equipment (chillers, pumps, cooling towers, CRAC units), lighting in the data center, physical security systems in the datacenter (access control, intrusion detection, surveillance), fire protection and similar systems, and system electrical losses (through transmission, conversion, etc.).

VA facilities generally have shared/integrated physical plants (mechanical and electrical rooms) that provide support to both data center and non-data center (administrative, patient care, etc.) spaces. Separate metering of the portion(s) of physical plants that solely provide support to the data center should not be expected to be available because of the mixed use and legacy nature of VA facilities. There are no simple, standardized methods of obtaining this information in the shared/integrated physical infrastructure environments typical in VA facilities.

VA uses a measure/estimate methodology to obtain this information. Estimate the fraction of the load of the device supporting the data center and multiply this fraction by the monthly energy usage of the device. This fraction is an engineering estimate of what percentage of the device's load is used to support the data center (as opposed to supporting non-data center loads). For example, based on how much chilled water flow goes to administrative office spaces versus to the datacenter (perhaps based on water pipe size), the site estimates that 65 % of the

chilled water goes to the data center. The total energy consumed by the chillers is measured at 1,460 kWh. The energy consumed to support the data center for that chiller for the month is 1,460 kWh * 0.65 = 949 kWh.

Individual sites are responsible for documenting the assumptions that they use to calculate and summate physical infrastructure electrical consumption. There are no standard templates for collecting, aggregating, or estimating this information because of the unique configuration of physical infrastructure systems at each VA facility. Consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility.

4.2.11.1.4 Total IT Equipment Energy Consumption

There are multiple ways to obtain Total IT Equipment Energy Consumption (TITEC) data, depending on the equipment that is installed in the data center. Use the most accurate method (methods are described from most to least accurate) to gather the metric information.

- If power distribution equipment (PDUs) in the data center have branch level metering, or if rPDU in the racks have rack-level power monitoring, whether this is connected to a facility Building Automation System (BAS)/Energy Management Control System (EMCS) (BAS/EMCS) or not, collect actual energy use data at the level closest to the IT equipment. Use of a BAS/EMCS to automatically collect and calculate this information provides the most accurate measurement.
- If PDUs in the facility have the capability to record kWh that they supply (and most modern units do), perform a manual (or automated, if BAS/EMCS capabilities are available) recording of the kWh reading on the PDU at a specified time for each reporting period (e.g., calendar month). For example, collect kWh numbers for all PDUs supporting the data center at 9 a.m. on the first calendar day of the month, and summate the change in kWh numbers from the previous period reading.
- Data centers generally have dedicated UPS systems to ensure IT equipment power is continuously available. At a specified time for each reporting period (e.g., calendar month), collect kWh numbers for all UPS systems supporting the data center and summate the change in kWh numbers from the previous period reading.
- For non-dedicated data centers and facilities where UPS systems also support non-data center administrative functions, follow the guidance for UPS kWh reporting above, and use a documented, realistic engineering estimate of the percentage of the UPS system power that is supplied to the data center IT equipment. This engineering estimate could involve counting the approximate number of amp-hours used by IT equipment in the data center and the approximate number of amp-hours that are used in a UPS-backed administrative space, and determining the ratio (3:1, or 75 %, for example). Use this estimated ratio (75 %, in our example) times the change in kWh numbers from the previous period reading to report the metric.

Where the data center does not have any of the previous metering equipment to assist in developing the metric:

- Provide a realistic engineering estimate of IT equipment power use by another method.
- Consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility.

An example of how to estimate a monthly total IT electrical consumption is to use a clamp-on electrical meter on the input power cords to a dedicated electrical distribution circuit panel, determine the amperage being provided during an assumed representative time period, multiply the amperage by the panel voltage, divide by 1.73 for three-phase distribution, and convert from power basis to energy basis by multiplying by 730 (average hours per month). Other methods may be more appropriate given the equipment in and configuration of a particular data center facility.

4.2.11.1.5 Total Uninterruptible Power Supply Load Energy Consumption

Data centers generally have dedicated UPS systems to ensure IT equipment power is continuously available. At a specified time for each reporting period (e.g., calendar month), collect Total UPS Load Energy Consumption (TUPSC) kWh numbers for all UPS systems and summate the change in kWh numbers from the previous period reading. For example, last month's kWh reading on UPS 1 was 220,000 and this month's reading is 235,000. Last month's kWh reading on UPS 2 was 350,000 and this month's reading is 375,000. The Total UPS Load Energy Consumption (TUPSC) for the month is (235,000-220,000) + (375,000-350,000) = 40,000 kWh.

Where UPS information is not available as kWh on the UPS, consult with local and enterprise facility and engineering staff as necessary and document the assumptions and process that will be used at the facility.

4.2.11.1.6 Total Renewable Energy Usage by Data Center

Total Renewable Energy Usage by Data Center (RENEW) is the ratio of consumed energy to be produced by renewable sources and the total electrical consumption. For example, Facility X's total electrical consumption provided by electric companies for August is 4,500,000 kWh. Facility X also pays for 250,000 kWh of electricity each month to be provided from wind farms. Facility X will report 250,000 kWh (5.56 %) renewable energy usage for August.

4.2.11.2 Rating 3 Power Metering Aggregation System

A data center level power metering aggregation system is a requirement for data center facilities intended to be Rating 3 (CDCs, CSCs, and some MSCs) to collect Energy Consumption Performance Metrics. All VA data center facilities shall report the following data within the period specified:

Table 22: Energy Consumption Performance Metrics

Performance Metrics	Units	Performance Goal	Period
Power Usage Effectiveness (PUE)	N/A	• New data centers < 1.4 with a goal of 1.2 • Existing data centers < 1.5	Monthly
Site Infrastructure Energy Efficiency Rating (SIEER)	N/A	N/A	Monthly

Evaluation Factors

- Data collection capabilities and intervals
- Data reporting capabilities and intervals
- Site-specific collection processes and engineering assumptions documented
- Performance metrics meet performance goals

Implementation Guidance

To meet aggregation system requirements for CDC, CSC, and some MSC data center facilities intended to be Rating 3, connect the data center aggregation system to enterprise DCIM system to enable Automated Energy Metering. Options for power consumption metering capability at the vertical rPDU (or PDU/BCP/RPP) level to satisfy this requirement include:

- Operate Branch Circuit Power Monitoring (BCPM) on all PDUs/BCPs/RPPs in the data center, with a single aggregation system.
- Operate single-vendor rPDU and aggregation system throughout the data center.
- Operate a single-vendor aggregation system. All rPDU must be compatible with the aggregation system. Replace noncompatible rPDU as necessary.

4.2.11.2.1 Power Usage Effectiveness

Power Usage Effectiveness (PUE) is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. PUE is defined as the ratio: (Total Data Center Energy Consumption)/(Total IT Equipment Energy Consumption) or (TEC/TITEC)

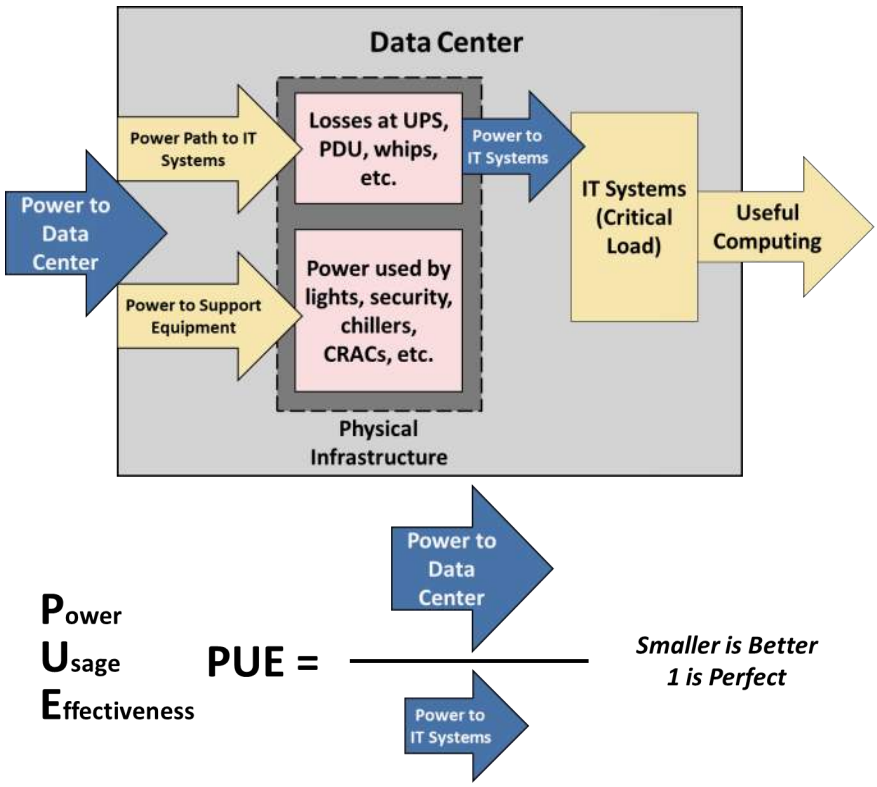

Figure 18: Power Usage Effectiveness

4.2.11.2.2 Site Infrastructure Energy Efficiency Rating

Site Infrastructure Energy Efficiency Rating (SIEER) is a dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. SIEER is defined as the ratio: (Total Data Center Energy Consumption)/(Total UPS Load Energy Consumption) or (TEC/TUPSC).

SIEER measures facility and data center efficiency differently than PUE, requires significantly less metering and monitoring equipment investment, allows VA flexibility in determining what is measured in shared-use (data center and administrative or hospital) facilities, and provides information that shows efficiency improvements over time between the data center and its host facility.

SIEER is defined as the total power coming into the facility divided by the total power being supported by the UPS system (technical power load, including the power necessary to operate the UPS and downstream power distribution equipment). While SIEER and PUE are similar efficiency metrics, they are not directly comparable.

4.3 Mechanical and Environmental Conditioning Standards and Monitoring

4.3.1 Introduction

This standard provides operational guidance for environmental condition requirements in telecommunications spaces. While design requirements for systems supporting these spaces are primarily the purview of the HVAC Design Manual, due to the unique nature of telecommunications spaces, designers must ensure that the designed systems will be able to meet the operational requirements described in the ISTS. Excepting air supplied for positive pressurization, telecommunications spaces are generally designed and operated as individual closed systems, therefor the design considerations differ from those of other space classifications.

The primary consideration for the provision of heat rejection systems in VA telecommunications spaces is energy efficiency. In all operating conditions, the design and operation of mechanical and environmental conditioning equipment shall consume the lowest amount of energy feasible. Optimize equipment teaming, operating sequences and controls, and the operating environmental conditions for IT equipment based on this objective.

Where guidance between the ISTS and the HVAC Design Manual differ, use the guidance in the more restrictive document for design decisions.

4.3.2 Environmental Operating Envelope Conditions

These specifications define the environmental operating envelope conditions and provide design and operations guidance for how to achieve and maintain those conditions in enterprise data centers. This Standard shall be used to specify and design computer room spaces and the environmental control systems and equipment to be operated therein.

VA data center environmental requirements are classified as Environmental Class A1 per American Society of Heating and Air-Conditioning Engineers (ASHRAE) Technical Committee TC9.9 thermal guidelines for data processing environments, requiring “tightly controlled environmental parameters (dew point, temperature, and RH)” to support mission-critical operations.

IT equipment load shall not exceed the overall cooling capacity of the data center. In general, 1 W of power consumed requires 1 W of cooling.

Excess demand requires re-engineering or self-contained high-density cooling solutions.

VA data center facilities shall maintain an average rack-face inlet temperature range of 72 °F to 80.6 °F. The average rack-face inlet temperature will be determined as the average of a standard three-sensor temperature measurement at the bottom, mid, and top height levels as measured 2 in. from the IT equipment inlets. For implementations that do not yet have the standard three-sensor installation, temperature shall be measured at 48 in. above the floor at 2 in. from the IT equipment inlets. Data center temperature and humidity conditions shall be

measured at the air intake to the IT equipment as described, rather than measuring the ambient or average condition(s) throughout the data center.

Cooling equipment set points will vary depending on equipment, set point thermocouple location, equipment location with respect to the IT equipment, and other factors. Establish and modulate the cooling equipment setpoint(s) to achieve the 72 °F to 80.6 °F equipment inlet temperature range while staying within the other (humidity, dew point) specifications. IT equipment exhaust temperatures shall not be used for determination of cooling equipment set points.

The design operating condition for cooling equipment in the data center environment is a 20 °F ΔT between supply and return airflows (e.g., across the heat transfer system of the cooling equipment). This industry standard temperature differential allows the rejection of 1 kW of heat using approximately 160 CFM of airflow. Design cooling systems to operate at a minimum of 20 °F ΔT in order to minimize energy usage by equipment fans.

VA computing facilities shall utilize engineered verified layout designs to optimize energy usage in the environmental control systems supporting the facilities. Proposed deviation from standard layout design requires verification and validation by DCIE and CFD analysis.

In general, HD racks shall be distributed across the entire data center floor to keep cooling systems from becoming ineffective.

Alternatively, dedicated HD areas may be employed with cold aisle containment to provide additional capability to power and cool to an average value below the peak enclosure value for HD equipment. Typically, this includes shortening the airflow path between the cooling system and the rack.

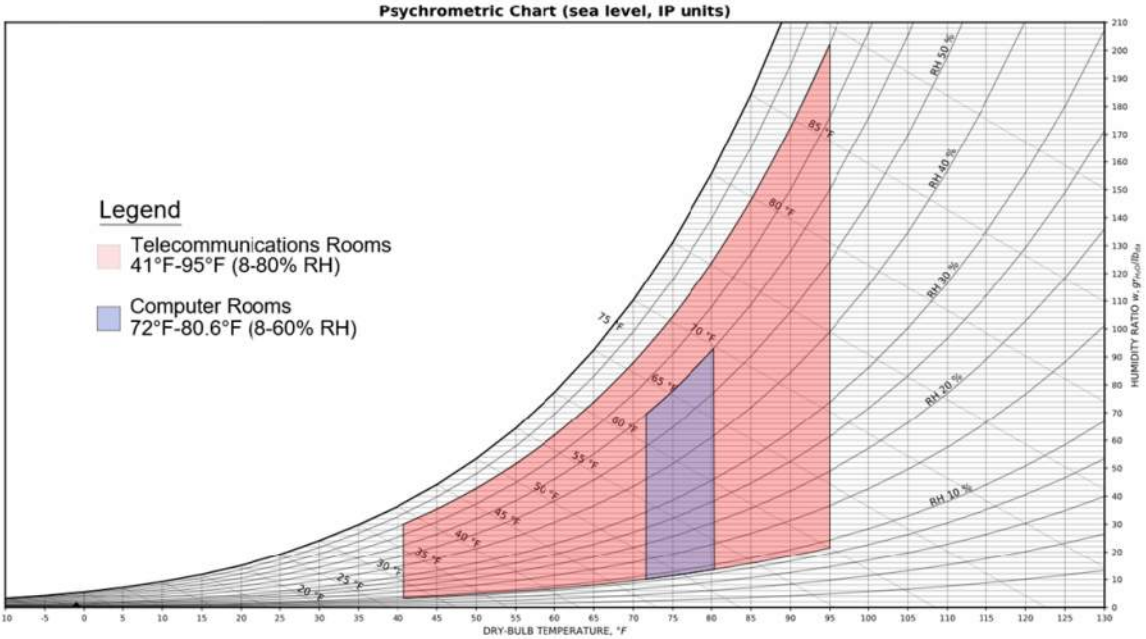

Figure 19: VA-Modified ASHRAE Environmental Classes for Data Center Applications

4.3.3 Data Center Facility Environment Conditioning Standards

Table 23: Data Center Facility Environment Conditioning Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Temperature (at IT equipment inlet)	72 °F to 80.6 °F dry bulb (VA modified recommendation is intentionally more stringent than ASHRAE minimum of 64 °F for additional energy savings)
		Humidity (at IT equipment inlet)	8 % RH to 60 % RH (in healthcare facilities, the more restrictive requirements of the HVAC Design Manual must be met)
		Dew Point (at IT equipment inlet)	≤ 59 °F
		Rate of Temperature Change	≤ 9 °F per hour
		Room Height (vertical dimension)	16 ft height (12 ft legacy) from finished floor to floor above, with larger heights preferable
		Monitoring	Varies by classification (see Amendments and Exceptions Tables below)
2	Environmental Control Equipment	Primary Air Conditioning Type	CRAC
		Airflow Plenum	Non-ducted architectural plenums (underfloor, above ceiling, etc.) should not be used in new construction or renovation of existing spaces
		Static Pressure (raised floor)	0.15 in. of Water Column (WC), Design distribution shall be not less than 5 kW (1.422 ton) of cooling per each 25 % perforated tile
		Airflow Tile (raised floor)	Placement per CFD analysis; typically: • 25 % open for SD racks • 50 % open for HD racks • Air Removal Units (ARU)/active tiles for unique hot spots
		Airflow Control Equipment (raised floor)	Fill in all floor penetrations to eliminate leakage to minimize cooling plenum static pressure loss

ID	Primary Attribute	Secondary Attribute	Specification
		High-Capacity Grate Tiles (raised floor)	May be used in the floor near HD areas (over 5 kW per rack) to eliminate hot-spots and air shortages
		Overhead Supply Air Ducts	• Vents directly placed over cold aisle • Placed as closely as possible to equipment intake • No lateral diffusing vents
		Ducted Systems Hot Air Return Vents	When used, placed as closely as possible to equipment exhausts or directly connected via flexible duct connections
		Blanking Panels	Required in every RU where no equipment resides on the front (cold aisle) of each cabinet
		Computational Fluid Dynamics (CFD)	Required for all new or significantly modified computer rooms (except NSCs)
		Containment Systems	• Must be considered for all new or significantly modified data centers • Required where close-coupled air conditioning is employed
		Rules-based Borrowed Cooling (existing data centers)	• Utilized for high-density deployment to borrow adjacent underutilized cooling capacity • Racks separated to prevent exceeding peak enclosure power and cooling values
		Close-Coupled Air Conditioning Systems	Used only with a containment system and when shown to be effective in CFD modeling

Evaluation Factors

- Temperature and humidity controlled within designated parameters
- Temperature and humidity measured at appropriate locations
- Bypass and recirculation air measures implemented
- CFD modeling used for data center design

Implementation Guidance

Relative humidity of the data center environment must not be less than 8 % to preclude static buildup and must not exceed 60 % to preclude water condensation, hardware corrosion, and early system and component failure.

Identify an environmental control window that is compatible with all the different thermal specifications, types of equipment, and equipment vintages in the data center for optimal energy saving.

CFD modeling shall be used iteratively in data center design to specify equipment requirements and location, duct sizing and location, control system designs, and operating guidance to minimize heat rejection system energy utilization in CDC, CSC, and MSC data center classifications at all operating states (from partially-loaded to ultimate design load).

Minimization of energy use by this system is a primary design consideration. CFD shall not be used to show that a design can be made to work without taking minimization of energy use into account.

4.3.4 Data Center Facility Environment Conditioning Standards (Amendments and Exceptions)

Amendments and exceptions to the requirements in Section 4.3.3 are listed in tables below for each class of data center to include NSC standards which are not covered above.

Table 24: Facility Environmental Requirements (CDC Amendments and Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Alarming	Automatic alarming when parameters are exceeded is recommended where automated systems are available
		Monitoring	Monitoring integrated into BAS with automatic alarming when conditions exceed prescribed limits

Table 25: Facility Environmental Requirements (MSC Amendments and Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Monitoring	Monitored by automatic system(s) in multiple locations, with indicators allowing operators to determine the general condition of the computer room

Table 26: Facility Environmental Requirements (NSC Amendments and Exceptions)

ID	Primary Attribute	Secondary Attribute	Specification
1	Environmental Envelope	Temperature (at IT equipment inlet)	For TRs only: 41 °F to 95 °F dry bulb (in healthcare facilities, the more restrictive requirements of the HVAC Design Manual must be met)
		Humidity	For TRs only: 8 % RH to 80 % RH (in healthcare facilities, the more restrictive requirements of the HVAC Design Manual must be met)
		Dew Point	For TRs only: ≤ 82.4 °F
		Room Height (vertical dimension)	No raised floor or suspended ceiling, maximize internal room height
		Monitoring	Monitored with indicators allowing operators to determine the general condition of the computer room
2	Environmental Control Equipment	Primary Air Conditioning Type	Air Conditioner Units in any NSC with active IT server and storage components
		Humidity Control Equipment	No dedicated humidity control equipment required
		Airflow Plenum	Not applicable
		Airflow Control Equipment	Not applicable
		Computational Fluid Dynamics (CFD) Modeling	Not required
		Containment Systems	Not specified

4.3.5 Environmental Control Equipment Requirements

Note: The classification of CRAC units, for the purposes of this document, includes Chilled Water (CW) Fan Coil Units (FCU), Computer Room Air Handler (CRAH) units, split system Direct Expansion (DX) CRAC units, and similar types of dedicated floor-mounted systems.

Table 27: Environmental Control Equipment

ID	Primary Attribute	Secondary Attribute	Specification
1	Computer Room Air Conditioner (CRAC) Equipment	Type	Only downflow CRACs shall be used except where other options can be modeled as the most acceptable efficient design in a CFD model.
		Total Cooling Capacity	Not less than 10 Refrigeration Ton (RT) per unit (*Note: NSCs and their subclass telecommunications spaces are covered separately*)
		Placement	CRAC units employed with raised access floors should be placed perpendicular to hot isles for effective air distribution supply to the cold isles. Applies to all configurations that use CRACs.
		Fan Type	• New and replacement units shall utilize Electronically Commutated (EC) fan technology • Upgrade centrifugal fan units with EC plug fans where feasible
		Variable Speed Drive (VSD)	• Shall be used in all possible applications • Fan(s) should be controlled by an automated VSD system provided internally to the CRAC or as supplementary external equipment powering the fans • Older CRAC units shall be retrofitted with VSDs

ID	Primary Attribute	Secondary Attribute	Specification
		Intake Chimneys	If not fully ducted return or connected to a return plenum: • Utilize CRAC intake hoods, extended returns, or chimneys on downdraft models to draw in heated air from the highest, warmest part of the room when possible to maximize ΔT across the cooling coils. • Do not extend hoods into a void ceiling space. • Leave at least minimum 18 in between top of chimney and the ceiling to allow return air to flow naturally into the chimney without constriction. • Retrofit existing CRAC units with hoods where feasible.
		Floor Stand	Where CRAC units are used in computer spaces with a raised access floor, they shall be mounted level with the finished floor level on an adjustable, seismic-rated floor stand designed for the equipment.
		Service Clearance	Provide clear space around units as recommended by the manufacturer (typically 36 in. on the front and each side)
		Control System	• Install a management control system for all computer rooms with two or more CRAC units. • The control system shall operate the system(s) in the most energy-efficient manner possible maintaining planned system redundancy levels, specified IT equipment inlet conditions, and maximizing the ΔT between the CRAC supply and return.

ID	Primary Attribute	Secondary Attribute	Specification
		Local Monitoring	Each CRAC shall have a local monitoring panel affixed to the unit accessing the following information: • System automatic restart with programmable delay • Sequential load activation • Sensor calibration • Current temperature set point and location of that set point • Current supply and return temperature and humidity • Unit diagnostics (fan, valve, alarm) • Alarm log history • Runtime log • Audible and visual alarm
2	Split System Air Conditioner Equipment	Operation	Automatic operation to maintain set point temperature in the telecommunications space for outside environmental conditions between the ASHRAE Fundamentals Weather Data 99.6 % column for Heating (Winter) and 0.4 % column for Cooling (Summer)
3	Portable Air Conditioner Equipment	General Usage	Shall not be used as part of a planned cooling system in VA data centers
		Emergency Usage	May be used for supplemental emergency cooling for short durations when primary equipment is unable to support the design load (e.g., until repaired)
4	Portable Fire Suppression	Type	Use only AHJ-approved clean agent portable fire suppression devices in telecommunications spaces

Evaluation Factors

- Equipment redundancy
- CFD analysis
- Energy efficiency
- Heat rejection capacity

Implementation Guidance

CFD modeling is required for all CDC, CSC, and MSC environments. CRAC unit placement and capacity shall be confirmed at computer room ultimate design load condition in all contingency conditions.

CRAC unit selection and placement shall be selected for the most energy efficient approach satisfying computer room ultimate design load condition in all contingency solutions. CRAC unit capacity shall be holistically balanced with computer room ultimate design load, considering required equipment redundancy.

CRAC unit operation shall be designed for the most energy efficient approach at all computer room loading conditions, operating within the prescribed environmental conditions, typically using Supply Air Temperature (SAT) and fan speed controls.

Each IT equipment enclosure in a data center environment (MSC, CSC, and CDC archetypes) shall have a minimum of 5kW of cooling capacity to be available. For design purposes, model the ultimate design load for these data center spaces to require the following amounts of heat rejection:

- Standard Density server cabinet - 5 kW (3.5 kW in raised floor environment used for cooling air distribution)
- HDA network channel rack - 2.8 kW
- MDA active equipment network channel rack or cabinet - 3.5 kW
- MDA passive equipment network channel rack or cabinet - 0 kW

Environmental control in NSC environments (including TRs and entrance rooms) shall typically be accomplished using dedicated split system air conditioners. Each installed enclosure requires 5 kW of cooling capacity to be available, but in aggregate 5kW per enclosure is not required.

Design heat rejection capacity in these telecommunications spaces as follows:

- 1-rack TR = 5 kW
- 2-rack TR = 7 kW
- 3-rack TR = 8.5 kW
- 4-rack TR = 10 kW

Other designs meeting these maximum expected aggregated load levels are acceptable. Multiple smaller units will assist in avoiding equipment freeze-up in some types of equipment.

4.3.6 Airflow Control

4.3.6.1 Room Height

Legacy facilities are encouraged to maximize room height (vertical dimension) through the removal of aesthetic suspended ceilings to maximize cooling efficiency.

4.3.6.2 Air Distribution Ceiling Plenums

In new designs, ceiling void spaces (above a suspended ceiling) shall not be used as plenum spaces for air distribution (return) except when fully ducted above a suspended ceiling. Legacy

facilities may continue to use down flow CRAC units with in-room and above-ceiling return designs. When used as a plenum (without ducting), the horizontal surfaces of the plenum must be periodically cleaned (vacuumed). Taking the friability of typical suspended ceiling acoustic tiles, their location above IT equipment, and the interface of other infrastructure equipment (lighting, fire suppression, structured cabling systems, etc.) into account, the maintenance requirement is not offset by the additional risks and costs incurred.

In existing spaces, unless directly ducted to the IT equipment rack discharges, do not extend CRAC intakes through a closed suspended ceiling, as this makes the space a plenum.

A recommended best practice is to remove suspended ceiling systems in data center facilities altogether to allow additional room for exhausted hot air to rise. Because cooling equipment efficiency is directly proportional to the change in temperature, extending CRAC intake ducts to the hottest exhaust air near the ceiling presents the greatest opportunity for efficiency.

Where the ceiling void space is used as a plenum return in existing (legacy) facilities, future physical infrastructure technical refresh projects shall change the air path to eliminate this usage.

4.3.6.3 Air Distribution Floor Plenums

The goal of using air distribution floor plenums is to provide uniform tile air velocity cooling effect across all perforated tiles or grilles.

Overhead cabling must be used whenever possible to eliminate possible airflow restriction. Under-floor obstructions such as network cables and power cords are minimized to prevent obstruction of airflow and cooling supply to the racks. Any excess unused shall be reclaimed to minimize blockage of air flow. Floor vents are not placed too close to CRAC units to avoid producing negative pressure which causes room air to be drawn back under the floor.

CFD analysis is required before selecting raised-floor solutions.

4.3.6.4 Perforated Tiles and High-Capacity Grates

Perforated tiles or grates are used to introduce cold air directly into the equipment intake in the cold aisle. An appropriate number of tiles or grates are used to match the load that is calculated in the cold aisle. Improperly placed tiles increase non-functional airflow and reduce the pressure of cold air flow where it is required. Placing too few in the cold aisle will cause recirculation and too many will increase the amount of bypass. If airflow efficiency cannot be optimized, bypass is preferred over recirculation.

High-capacity grate tiles may be used in the floor near HD areas (over 5 kW per rack) to eliminate hot-spots and air shortages. These should not be automatically addressed by installing high-capacity grates without considering the complications that may be introduced:

- High-capacity grates pass three times more air than normal capacity tiles and may alter the fixed pressure that is required to feed cold air to other servers
- Additional forced air may bypass the intended target equipment and flow right past the faces to the top of the aisle providing no benefit

- Creates large airflow variations
- Dramatically alters under-floor pressure gradients, making cooling non-uniform and unpredictable
- Impacts airflow in neighboring areas. Some locations will NOT receive sufficient cooling
- Air Removal Units (ARU) or active floor tiles are used to improve targeted air flow for higher density racks

A recalculation of CFD modeling is required when high-capacity grates or active floor tiles are added or relocated.

4.3.6.5 Air Containment Devices

Where an underfloor plenum is used for cooling air distribution, all access floor penetrations shall be sealed with authorized materials such as brushed floor grommets and air dam foam sheets to maintain the rating of any fire and smoke barrier and to minimize cooling plenum static pressure loss.

4.3.6.5.1 Brushed Floor Grommets

Figure 20: Brushed Floor Grommet

4.3.6.5.2 Air Dam Foam Sheets

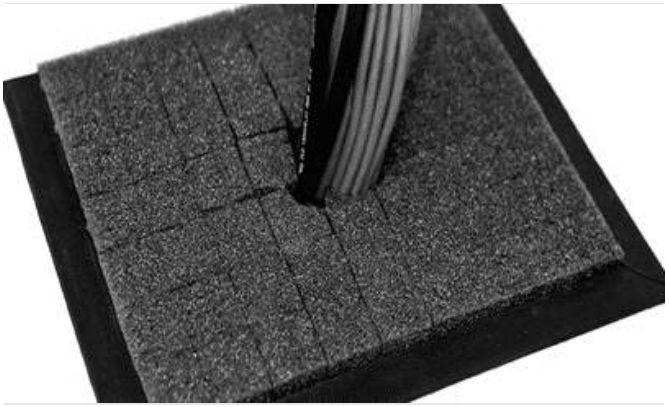

Figure 21: Air Dam Foam

4.3.6.5.3 Blocking Recirculation Paths

Recirculation air from gaps between and under racks and cabinets has been shown in CFD analysis and thermal survey measurements to be a significant contributor to cooling inefficiency in VA data centers.

Ensure that IT equipment racks and cabinets are installed flush to one another without air gaps between the racks. Use appropriate materials to fill gaps between racks to prevent recirculation of exhaust air to the cold aisle.

Install baying kits are required to keep cabinets aligned.

Install blanking materials under IT equipment racks and cabinets in the same plane as blanking panels.

4.3.6.5.4 Blanking Panels

Blanking panels reduce hot spots and recirculation of air by preventing equipment exhaust air or hot-aisle air from migrating to the conditioned air-intake stream at the front of IT equipment racks or cabinets.

All IT equipment racks and cabinets shall have blanking panels and air dams installed in all positions within the enclosure that do not contain equipment to prevent recirculation of cooling airflow.

Failure to do so causes hot exhaust air to mix with the cool supply air (see Figure 22 Example A below) and does not allow for an adequate amount of cool air to reach the intake of all the equipment present in the rack. With blanking panels installed (see Figure 22 Example B below) the hot air does not have a path back to recirculate so only cold air is provided to the equipment intake.

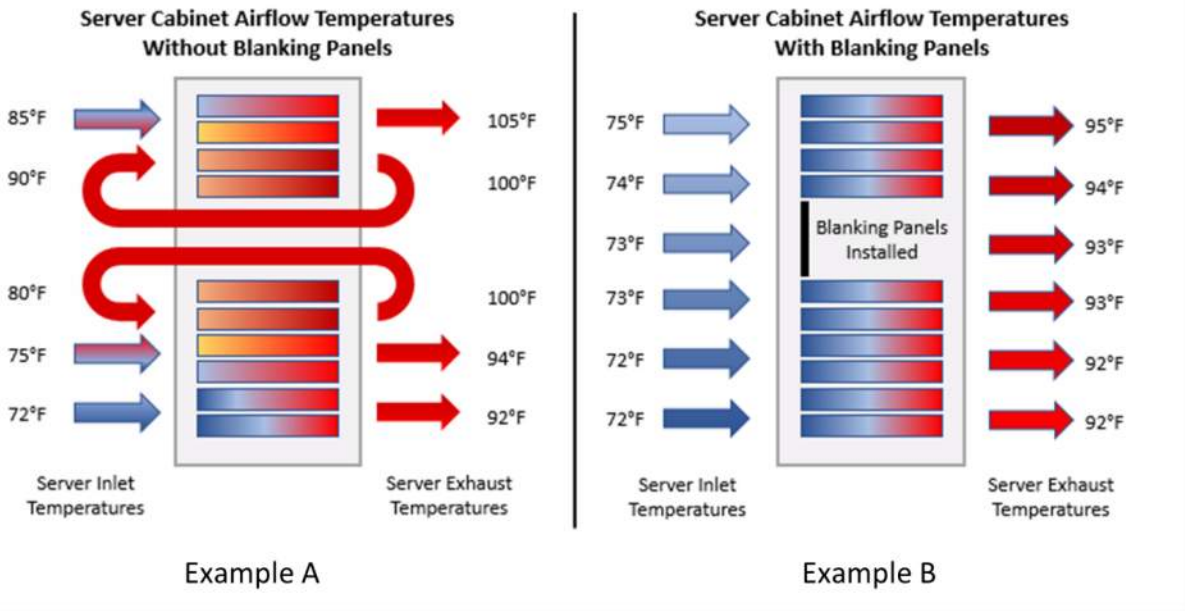

Figure 22: Blanking Panel Application

When angled patch panels are used, angled panel covers are a requirement to block airflow over and under the patch panel. Angled blanking panels can be used between angled patch panels; however, angled panel covers must be used at the top and bottom of an angled stack.

Seal other cabinet holes that traditional blanking panels and panel covers do not fit with manufacturer sealing kits.

Other air containment solutions including expanding foam pillows, fire-stop caulking, temporary metal or fiberboard cover plates, and commercial expanding foam are not acceptable for use in VA data centers; they are either temporary, are not flexible enough to allow for re-cabling, require replacement during any changes, or may present fire and safety hazards.

4.3.6.5.5 Air Distribution Containment Systems

Legacy VA data centers typically use the entire room volume as a heat sink, the least efficient and least effective manner of controlling temperatures and humidity.

Air containment systems may increase the efficiency of data center HVAC systems by separating cold supply and hot return air streams, allowing hotter and drier air to be introduced to the CRAC unit or close-coupled cooling system. The efficiency of these systems is directly proportional to the ΔT between the air streams.

Containment systems may be installed in any VA data center to improve the efficiency and/or effectiveness of the HVAC system. Containment systems are required to be installed in all VA data centers where close-coupled cooling systems are employed. Both hot and cold containment system designs are acceptable and may be appropriate for use in VA data center

facilities. Use CFD modeling to determine which design solution(s) will be most effective and cost-effective prior to implementation.

Local AHJ fire and safety standards may supersede this Standard or make containment solutions cost prohibitive.

4.3.6.5.6 Containment Equipment

Use the most cost-effective containment solution available that will satisfy the efficiency design criteria for a given implementation. Hard walls, sliding doors, and hard roofing containment which may be difficult to retrofit and cost prohibitive, while often the most effective containment, are not required. Polyvinyl chloride (PVC) strip curtain walls (vinyl sheeting) solutions, which are inexpensive and the least complicated solutions to install, are acceptable.

When containment is used, consideration must be given to fire alarm and suppression systems to ensure containment systems do not interfere.

4.3.6.5.7 Cold Containment

Cold containment solutions are intended to collect and contain cold (supply) air from cooling units (CRACs) at the inlets of the IT equipment. Design and operate cold containment solutions such that appropriate volumes of air are presented (generally a 10 % overpressure) to the cold containment zone to provide enough pressure to inhibit reintroduction of hot air into the containment but not overly pressurized to avoid inefficiencies with bypass airflow (either excess air being forced through IT equipment or leakage due to over-pressurization). Cold containment retrofits will generally require the least amount of equipment to implement.

Cold containment may be used in conjunction with heat containment solutions to achieve air stream separation goals. Partial cold containment solutions, when used with proper airflow management equipment, can provide significant efficiency returns with minimal amounts of investment. For example, the addition of end-of-row containment doors, with no other containment, may improve airflow efficiency up to 15 % in some data centers.

4.3.6.5.8 Heat Containment

Heat containment solutions are intended to direct hot (exhaust) air from IT equipment racks away from areas that it can mix with cold (supply) air entering the IT equipment rack face. Heat containment may be used in conjunction with cold containment solutions to achieve air stream separation goals.

4.3.6.5.9 Chimney Return Systems

An effective subset of heat containment, chimney VED return systems direct the exhaust from IT equipment racks vertically to a ducting system that returns the hot air stream directly to the CRAC unit intakes without mixing. This variant on heat containment requires extensive installation work, limiting its ability to be implemented in operational data centers.

Do not employ chimney systems without ducted returns unless the finished ceiling is at least 12 ft and chimney has 18 in. of clearance below the ceiling to allow for natural, unrestricted airflow.

4.3.6.6 Heating, Ventilation, and Air Conditioning Environmental Control Equipment

In general, legacy VA data centers use a pressurized subfloor air distribution plenum for cooling air distribution to IT equipment. It is not necessary for future VA data centers to use this model if other, more efficient and effective environmental control models can be used.

Alternative air conditioning types are allowable provided they increase the efficiency of the HVAC system and do not provide more cooling than the ultimate design load of the data center (for example, do not install a 5-ton CRAC unit in a NSC designed to contain one ton of IT equipment).

4.3.6.7 Computer Room Air Conditioner Units

Floor-mounted CRACs are generally used in conjunction with raised access floor distribution plenums in legacy VA data center facilities. Where used with a raised access floor, CRACs shall be supported by manufacturer-specified, seismic-rated floor stands independent of the access floor.

Utilize high-efficiency Electronically Commutated (EC) plug fans in CRAC units. Retrofit legacy CRAC units with EC plug fans for increased operational efficiency where feasible.

4.3.6.8 Split-System Air Conditioning Units

Split-system air conditioning units are air-cooled Direct Expansion (DX) or water-cooled units which are systems typically with a ductless connection between a compact heat exchanger component in the interior space and a condenser (heat rejection) component external to the controlled environment that is either wall mounted or is mounted within a suspended ceiling system. These units are only appropriate for use in small, non-critical, distributed VA data centers and other small IT-related spaces. The typical configuration of these rooms is a local server room or TR. Size these systems to match the ultimate design load of the space. Due to the non-critical nature of IT equipment operating in these facilities, redundant equipment is not required.

4.3.6.9 Portable Air Conditioning Units

Portable air conditioning units (air-cooled or water-cooled) are considered inappropriate for long-term use in VA data center spaces and shall only be used for temporary spot cooling purposes in the event a primary system is inoperative. Portable units shall not be used to increase the cooling capacity of a VA data center to increase the amount of IT equipment that can be installed.

4.3.6.10 Close-Coupled Air-Conditioners

The use of close-coupled air conditioning systems is permitted in VA data centers when the systems are specifically designed into the support model. In general, use close-coupled systems

in portions of the data center designed for HD (> 5 kW per IT equipment rack). When close-coupled systems are used, containment must be implemented in the zone(s) where the systems are installed.

Close-coupled systems shall not be used to increase the amount of cooling available within a data center unless the power being supplied to the data center is simultaneously being increased (increased design capacity in both power and cooling must match).

4.3.6.11 Fans and Supplemental Airflow Augmentation Devices

The use of fans and supplemental airflow augmentation devices in VA telecommunications spaces is prohibited without CFD analysis confirming their necessity and environmental benefit in the proposed operating environment.

Floor-mounted and portable fans shall not be used in computer rooms or TRs; provide appropriate permanent heat rejection and air circulation equipment instead. Do not use fans to evacuate heat from IT equipment enclosures (except as an integral part of TE design).

4.3.6.12 Humidity Control Equipment

Humidity control equipment shall be used in VA data center facilities to allow operators to maintain the computing environment within the allowable operating parameters and to minimize the energy required to provide a stable and efficient environment for IT equipment.

System design shall comply with ANSI/ASHRAE Standard 188 (current version) and VHA Directive 1061 for Legionella control.

Defer to the HVAC Design Manual for additional guidance.

Evaluation Factors

- CFD Analysis
- IT equipment inlet environmental conditions
- CRAC set points
- CRAC fan speed control
- CRAC intake chimneys
- Floor to ceiling height
- Design redundancy levels maintained

Implementation Guidance

Environmental control of VA data center spaces shall be based on the IT equipment requirements and not cooled for human comfort. Significant energy intensity reductions can be made by modifying these environmental control parameters and ensuring appropriate airflow paths and systems are designed, operated, and maintained. Retrofit all VA data center spaces for maximal energy savings as rapidly as feasible. Operate CRAC units only as required to maintain prescribed operational parameters.

4.3.7 Monitoring

Table 28: Monitored Conditions (MSC, CSC, and CDC)

ID	Primary Attribute	Secondary Attribute	Specification
1	Monitored Conditions	Fire Protection	• VA telecommunications space fire protection systems shall be as required by the VA Fire Protection Design Manual. Where allowed by the AHJ, fire protection for CSCs and CDCs shall use an early-warning Aspirated Smoke Detection (ASD) system such as Very Early Smoke Detection Apparatus (VESDA).
		Water Detection	All CDCs, CSCs, and MSC shall install a liquid water detection system in all data and infrastructure spaces (not required for NSCs). Required in: • Raised floor spaces • IT spaces where water sources exist in or above electronic equipment • HVAC chiller rooms • Fire suppression system areas (pumps and controls)
		Power	All data centers shall monitor continuity and quality of: • Utility power delivery • UPS power output • Auxiliary generator power output • Branch circuit power output
		Temperature - Equipment Cabinets	• All VA data centers shall monitor air temperatures at multiple points in IT equipment cabinets. Exact quantity and placement of sensors shall be determined according to the design and implementation of airflow management measures to ensure an adequate supply of cooling air • All equipment cabinets in facilities lacking best-practice airflow management shall have at least four sensors per cabinet as per sensor location specification below

ID	Primary Attribute	Secondary Attribute	Specification
		Temperature - CRACs	All VA data centers shall monitor supply air and return air temperatures: • Supply air temperature shall be monitored at the output of each physical infrastructure device supplying cold air, whether the device is active or not • Return air temperature shall be monitored at the intake of each physical infrastructure device supplying cold air, whether the device is active or not
		Humidity - CRACs	All VA data centers shall monitor supply air and return air Relative Humidity (RH): • Supply air RH shall be monitored at the output of each physical infrastructure device supplying cold air, whether the device is active or not • Return air RH shall be monitored at the intake of each physical infrastructure device supplying cold air, whether the device is active or not
2	IT Equipment Cabinets	Temperature and Humidity Sensors	To ensure an adequate supply of cooling air, all IT cabinets in facilities lacking best-practice airflow management shall have at least four temperature sensors per cabinet and one humidity sensor as per sensor location specification below
			IT Cabinets in facilities with best-practice airflow management may use fewer sensors, meeting the following minimum criteria: • Sensors in cabinets at the ends of a contiguous row/string • Sensors in every third cabinet in the middle of a contiguous row/string • At least two sensors per monitored cabinet • Temperature sensors in the Front Middle (FM) and Rear Top (RT) locations • Humidity sensor in the FM location

ID	Primary Attribute	Secondary Attribute	Specification
		Sensor Locations	IT Equipment Cabinet temperature sensor locations shall correspond to VA modified ASHRAE-recommended monitoring locations: • Front Top (FT): Centered horizontally, inside the front door, no more than 1 ft from the top of the cabinet • Front Middle (FM): Centered horizontally, inside the front door, 4 ft +/- 6 in. from the finished floor surface • Front Bottom (FB): Centered horizontally, inside the front door, no more than 1 ft from the finished floor surface • Rear Top (RT): Centered horizontally, inside the rear door, no more than 1 ft from the top of the cabinet One humidity sensor in the FM location
3	Communication Protocols	IT Devices	Monitored IT Devices shall use SNMP, configured in a secure mode as required by the TRM. Implementations shall adhere to the VA LAN Security Standard: • SNMP v3.0 secured using SSL • SSL using Secure Hash Algorithm (SHA-1) authentication • Advanced Encryption Standard (AES) Encryption, at 128-bit or the highest level supported by the attached hardware
		Monitoring Systems	To support data stream integration, monitoring systems shall support Secured SNMP v3.0 for upstream communication and **at least one** of the following industrial communication protocols to receive sensor data: • BACnet or BACnetIP • Modbus or Modbus IP • CANbus or CANbus IP • Fieldbus or Fieldbus-IP
		Monitoring Devices	Monitoring devices and systems shall be capable of communication using **at least one** of the following protocols: • Secured SNMP v3.0 • BACnet or BACnetIP • Modbus or Modbus IP • CANbus or CANbus IP • Fieldbus or Fieldbus-IP

ID	Primary Attribute	Secondary Attribute	Specification
		Physical Infrastructure Devices	Infrastructure device communication modules shall support **at least one** of the TRM approved protocols: • Secured SNMP v3.0 • BACnet or BACnet IP • Modbus or Modbus IP • CANbus or CANbus IP • Fieldbus or Fieldbus-IP

Evaluation Factors

- Facility actively monitors all required monitoring points
- IT equipment rack temperature/humidity sensors installed as described in ISTS.
- Water detection system design
    - Point leak detection units
    - Zone leak detection panels
    - Linear detection systems
    - Wire-free sensors
    - DCIM integration
- Monitoring systems and equipment comply with communications protocol requirements

Implementation Guidance

IT equipment rack temperature/humidity sensors are required for MSC, CSC, and CDC data centers where there is separation between cold and hot air streams. Sensors are not required in TRs or entrance rooms where heat rejection is accomplished using the entire room as a heat sink.

Monitoring shall be defined as continual real-time observation of a condition or set of conditions affecting computing spaces.

Connect all vertical rPDUs to the rPDU monitoring system. Maximize connectivity of facility equipment within the data center to the rPDU monitoring system.

Provide output feeds from the system to the FMS building monitoring system for remote monitoring capabilities.

Functional definitions of monitoring and metering shall not be interpreted to require separate systems; a single sensor, device, or system may support multiple monitoring and metering functions.

Detection, alerting, and alarming functions, as well as automatic triggering of interventions, shall be considered part of a monitoring system.

Monitoring systems collect forensic data during a period when a detection threshold has been exceeded.

Alerts are communicated when a condition threshold has been reached or exceeded. Alert triggers shall be set to provide sufficient reaction time to respond to, investigate, and correct the underlying cause of the condition.

Alarming systems shall communicate when an absolute limit has been exceeded.

4.4 Telecommunications Standards

Work-Area Outlets (WAO), media, media connectors, and patch panels shall support the minimum performance and capacity requirements of this Standard.

All cabling system components shall be of the same performance category across each entire channel. Components typically may not be mismatched with respect to performance category. For example, where copper telecommunications cabling is used, all components – channel cabling, patch panels, jacks, receptacles, and patch cabling – shall have the same category designation. However, mixed environments are acceptable when supporting a planned upgrade path. For instance, Category 6A (Cat 6A) U/UTP patch cords can be used with Cat 6 patch panels knowing that the performance of the entire channel is at the capability level of the lowest performing component until the upgrade plan is complete.

The specifications for horizontal cabling for LAN applications and cabling for intra- and inter-building backbone are laser-enhanced fiber optics and high-bandwidth UTP. The minimum bandwidth requirement for fiber is 40 Gigabit Ethernet (GbE) and 10 GbE on UTP.

Media types not expressly authorized by this Standard are prohibited for use except for in the direct interconnection of IT equipment within the same enclosure.

IT equipment including both UTP data cabling and active equipment should not be operated in environments where an AC magnetic field level exceeds 12.6 milliGauss (1 A/m). Designers shall provide sufficient separation between EMI sources (i.e., transformers, electric motors) and IT equipment to meet this requirement.

Communications cabling must not be painted. Paint, plaster, cleaners, abrasives, corrosive residues, or other contaminants may result in an undetermined alteration of the cable properties.

Counterfeit communications cabling and termination hardware is a significant problem in the low-voltage industry. It puts entire projects at risk of post-installation performance failure across ISP and OSP infrastructures and it could potentially lead to fire risk since this media may not actually be certified for flame-spread or smoke toxicity. Furthermore, advertised performance ratings may not be achievable. Therefore, all telecommunications media specified and installed for VA projects must be listed by a Nationally Recognized Testing Laboratory (NRTL). The listing status of communications terminating hardware and media delivered to job sites must be confirmed through cross-referencing UL Solutions. UL Certification marks consisting of holographic labels or other verifiable NRTL marks prove that these products are not counterfeit and meet applicable performance and safety ratings prior to unboxing and installation.

Note: Signal cable consisting of copper-clad-steel and copper-clad-aluminum is not permitted for use in VA projects. It is incumbent upon VA staff with authority over any given project to confirm and document ongoing compliance.

This Standard has been harmonized with OIT LAN Baselines.

4.4.1 Structured Cabling

This Standard requires structured cabling as a vendor-neutral, extensible approach to information transport system design in VA facilities, *not limited to data center applications*. All local and campus area networks shall be installed in a structured topology with patch panels serving transition points. Individual "home run" cables are not permitted for LAN applications, including data centers.VA employs a single converged physical telecommunications infrastructure model to support all the telecommunications needs of all consumers of these services at a single campus or facility. Installed cable plant systems (both ISP and OSP) are designed and intended to be shared among the multiple possible users (OIT, CE, FMS, VA police, etc.). Individual projects for systems for any user at the campus or facility shall follow the structured backbone and horizontal distribution model described in these Standards, use equipment and components described in Division 27 specifications and these Standards, utilize already-installed backbone media where it is compliant with these Standards, and follow established OIT processes for isolation architectures to reduce operational risks both to user systems and to the VA network.

New cable plant systems that are not part of the converged physical telecommunications infrastructure are prohibited.

Installation of new equipment and/or systems intended to use legacy cable plant systems rather than the converged physical telecommunications infrastructure are prohibited. All new equipment and/or systems shall, where feasible, be designed and installed to use the converged physical telecommunications infrastructure. Variances may be granted where these systems operate on physical media or protocols that cannot utilize the converged physical telecommunications infrastructure (e.g., coaxial cable).

Legacy cable plant systems (e.g., telephony Cat 3 station cabling, telephony distribution frames, dedicated fiber backbone elements serving specific systems) shall be abated during any modernization project work, including replacement of active equipment being served by the legacy media.

Structured cabling requirements shall be accounted for in all projects impacting the telecommunications infrastructure. Data Center and Infrastructure Engineering are stakeholders in every project involving the physical cable plant installed at a campus or facility, including CE, FMS, and VA police projects that intend to install additional cable plant media, and shall be included in project review to ensure compliance with the converged physical telecommunications infrastructure model.

4.4.1.1 Campus Structured Cabling

In general, fiber optic backbone directly connects the entrance rooms and antenna entrance rooms to the data center's MDAs and the data center MDAs to the TRs. Pathway redundancy requirements are based on the classification archetype of the data center.

Due to a broadly-demonstrated inability to effectively manage and maintain them, the use of Intermediate Cross-Connects (ICCs) between the MDAs and TRs is prohibited in VA campus structured cabling systems.

In general, copper UTP horizontal distribution connects the TRs to the end-user WAOs.

Field termination of media is expected for campus structured cabling systems.

Any differing approaches (e.g., use of fiber optic media for horizontal distribution, or of a Passive Optical Network (PON) to support a campus or part of a campus) to the campus structured cabling must be approved in writing by Data Center and Infrastructure Engineering.

4.4.1.2 Computer Room Structured Cabling

Data center structured cabling systems are required in the MSC, CSC, and CDC facility classifications. This approach is consistent with ITS industry standards, and it supports the SD LAN and data center network design baselines.

These structured cabling systems shall use a redundant, diversely-routed end-of-row (EOR) HDA distribution model supported by redundant MDAs where the main cross-connect is located as defined by ANSI/TIA 942-B specifications.

All elements of these data center structured cabling systems shall be located in the data center installed in overhead cable tray systems. Both HDAs, which serve as the distribution point for horizontal cabling and houses horizontal cross-connects and equipment for connecting to the equipment distribution area and the MDA, should be located adjacent to switching components within the rack to minimize patch cord length and cable management requirements.

All IT equipment will be supported from the HDA elements using the structured cabling system. All networking equipment will be located in the network channel racks and all server/storage equipment will be located in the server cabinets provided in these designs. NSCs using a server cabinet shall follow a modified structured cabling environment appropriate to the specific requirements of the environment.

The use of top-of-rack (TOR) switches and similar networking equipment within server cabinets is prohibited.

The use of pre-terminated structured cabling elements is required in the data center. Specification of data center structured cabling (both copper and fiber) requires calculation of total length of the link pathway in all dimensions (orthogonally) from dimensionally accurate plans. Procure structured cabling elements to not exceed 6 ft (2 m) at each end from the calculated length to avoid coiling of excess cabling.

Media and patch panel quantities for the computer room structured cabling system are based on the Standard Density server cabinet. Equipment Distributors in standard density server

cabinets support A/B redundant cabling with each side consisting of a minimum of 12 duplex LC (two 12-strand MPO cables) and a minimum of 24 UTP cables. Upstream requirements in HDAs and MDAs are based on the quantity of server cabinets in the data center's master plan.

4.4.2 Unshielded Twisted Pair

This Standard specifies pre-terminated Category 6A (Cat 6A) U/UTP for horizontal distribution. This performance category is applicable to field-terminated or factory pre-terminated cabling for UTP with each cable terminating in an individual connector. While pre-terminated cables require that distances between termination points are known this approach results in the rapid installation of horizontal cabling without risks associated with field termination including wire fragments, impaired cabling performance due to poor installation techniques, faulty terminations, etc. Spiral wrapping pre-terminated bundles is an effective way to maintain the bundle of six cables without impacting ease of installation.

Factory pre-termination is the preferred termination method, but field-termination is acceptable for work-area distribution applications and where pre-termination is impractical such as in horizontal distribution from TRs.

Cat 6A cabling is specified in standard ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure for new installations.

Copper Clad Aluminum (CCA) cable is not permitted.

Table 29: Unshielded Twisted Pair Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics (Horizontal and First Level Backbone)	Performance Category	• Cat 6A (10 GbE) • Cat 6 (exempted and authorized variance only)
		Performance Specifications	Meets or exceeds TIA-EIA-568.2-D and TSB-155
		Conductor Size	22 AWG to 24 AWG
		Limited Power (LP) Certification	UL Listed as x-LP (0.5 A)
		Termination Method	• Pre-terminated, 8P8C with TIA-568-B termination method preferred, OR • Field-terminated with TIA-568-B termination method where distances cannot be precisely calculated
		Cable Length	Pre-terminated cables not to exceed 6 ft (2 m) of excess length on each end

ID	Primary Attribute	Secondary Attribute	Specification
		Media Connector	• 8P8C • Modular Plug Terminated Link (MPTL) authorized for media connecting to Wireless Access Points (WAPs)
		Bundling	Multiple cable harness

Evaluation Factors

- Performance category tuned to match all channel components
- Performance characteristics
- Conductor size
- Termination (factory or field)
- PoE
- Compatibility with specified patch panels
- Combustion rating

Implementation Guidance

Category 6A UTP is required for all new installations for clinical spaces to meet ANSI/TIA-1179 and 10 GbE performance objective.

Cat 6 UTP may be specified for installation for strictly administrative areas with an approved variance from DCIE (see Appendix A:).

Retrofit/replacement decision points to meet minimum 1 GbE objective on legacy cable plant:

- Cat 5e replacement with Cat 6A strongly recommended
- Interim full testing of Cat 5e channels to verify 1 GbE performance.
- Cat 5 or below – replacement with Cat 6A required
- Failed Cat 5e permanent link test – Interim repair, replacement with Cat 6A required

Horizontal channel distance for UTP is limited to 90 m with 10 m reserved for patch cords.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation. Only use field terminations to WAOs

Distribution to WAP locations may be terminated Modular Plug Terminated Link (MPTL) rather than using 'biscuits,' eliminating the requirement for a connecting patch cord.

Shielded twisted pair media (e.g., STP, FTP, S/FTP) are not recognized to have any applicable use cases in typical usage in VA telecommunications systems. In addition to requiring specific additional interface equipment, having a higher procurement and installation cost, and requiring bonding beyond the requirements for UTP, VA configuration management and maintenance capabilities are insufficient to ensure that the intended purpose of these types of media can be sustained.

Over the past decade, power-over-LAN cable technologies such as PoE have become a viable powering option for a wide range of applications. Anticipating future standards, device

manufacturers are pushing the envelope and designing more sophisticated equipment that demands increased power. As the power is increased, the heat generated within the cable increases as well. This is especially true when the cables are bundled. The additional heat generated by the increased current could push the cables beyond their rated temperatures. To address this concern, UL has introduced a Limited Power (LP) certification to simplify the cable choice and installation considerations. The "-LP" cable designation indicates that the cable has been evaluated to carry the marked current under reasonable worst-case installation scenarios without exceeding the temperature rating of the cable. The certification accounts for large bundle sizes, high ambient temperatures, and other issues related to environmental effects, such as enclosed spaces or conduits. If LP certified cable is not used, the number of cables that can be bundled or enclosed in a sealed raceway will be limited per the specifications in the associated NEC ampacity chart.

Where practicable, this Standard recommends Cat 6A UTP with a minimum LP rating 0.5 to support PoE technology up to 100 W. This specification is shown as "UL Listed as x-LP (0.5 A)." If running Type 4 PoE, cables without LP certification are subject to inspection to ensure bundle size and current limitations per the NEC ampacity table are not exceeded.

See Sections 4.4.1 and 5.3.2 on cable routing and implementation.

4.4.3 Unshielded Twisted Pair Patch Panels

Patch panels shall serve as transition points for all horizontal cabling in equipment distributors and horizontal distributors and throughout the MDAs for all backbone and horizontal levels.

This Standard anticipates the bandwidth demands of virtualization by specifying Cat 6A UTP in production and test facilities. This Standard can be applied to field-terminated or factory pre-terminated applications. The preferred termination method is factory pre-terminated cabling for UTP. Cat 6A cabling is specified in standard ANSI/TIA-1179 Healthcare Facility Telecommunications Infrastructure for new installations.

Modularity of structured cabling components in the TRs, entrance rooms, and data centers improves capacity planning and move/add/change outcomes. This Standard specifies a one-RU high, 24 or 48 position patch panel that is performance-tuned to the UTP. Angled panels eliminate the need for horizontal cable management in the rack and are the typical configuration. No horizontal cable management is required when specifying angled panels.

Table 30: Unshielded Twisted Pair Patch Panel Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	• Cat 6A (10 GbE) • Cat 6 (exempted and authorized variance only)
		Position Count	24/48

ID	Primary Attribute	Secondary Attribute	Specification
		Form Factor	• 1 RU • Angled
		Components	• Angled panel cover • Rear cable manager

Evaluation Factors

- Performance category tuned to match all channel components
- Form factor
- Compatibility with pre-terminated cable interfaces
- Channel installations (including patch panel equipment on each end) certified to media performance category using level IIIe test equipment per ANSI/TIA-1152

Implementation Guidance

Patch panels shall serve as transition points for all horizontal cabling in equipment distributors and horizontal distributors, and throughout the MDAs for all backbone and horizontal levels. The patch panels at the HDA and MDA shall be located in the same rack with the switching components to minimize patch cord length and cable management requirements.

Where installed, the ED patch panels will be installed in the top five rear RUs of each enclosure or within small (five RUs or fewer) pathway racks mounted on cable tray above the associated equipment cabinet.

4.4.4 Unshielded Twisted Pair Patch Cord

This Standard specifies center-tuned Cat 6A (or Cat 6 exempted and authorized variances only) patch cords. This Standard does not specify color-coding for patch cord jackets. Based on the observations of hundreds of VA facilities, color-coded patch cords provide little or no utility and create inventory management issues. Effective color coding has been observed for in-rack, dual-homed server/appliance applications using a simple white/black scheme. Patch cords shall be factory pre-terminated and shall match or exceed the category of the associated patch panel and connected UTP.

Table 31: Unshielded Twisted Pair Patch Cord Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	• Cat 6A (Cat 6 exempted and authorized variance only) • Stranded

ID	Primary Attribute	Secondary Attribute	Specification
		Jacket Color	Not specified
		Termination Method	Factory pre-terminated
		Conductor Size	22 AWG to 28 AWG

Evaluation Factors

- Performance category tuned to match all channel components
- Performance characteristics
- Center-tuned to installed patch panels
- Patch cords of shortest appropriate length used

Implementation Guidance

Use most appropriate length to meet cable management standards.

The use of 28 AWG cords is allowable; however, the reduced overall horizontal channel distance and other factors must be considered when used:

- Total allowable patch cord length is reduced from 32 ft (10 m) to 20 ft (6 m) (see Table 1. ANSI/TIA-568.0-E)
- The total channel (patch cords plus permanent link) length maximum is, therefore, reduced from 321 ft (98 m) to 315 ft (96 m)
- The maximum bundle size (cables and cords bundled together with hook and loop straps) is twelve (see Annex Q. TIA-568.2-D-2)
- Per VA and industry standards concerning DC powering over UTP, Category 6A 4-pair balanced twisted-pair cabling as specified in ANSI/TIA-568.2-D is required media for the permanent link (see Annex A. TIA TSB-184-A)
- The patch cord performance category must meet or exceed the performance of the permanent link (regardless of patch cord OD). Maximum individual patch cord length is limited to 10 ft (3 m) to eliminate use of patch cords for horizontal or backbone connectivity.

ISP design best practices dictate that component-level compliance to a performance standard must be maintained across the entire horizontal link. The quality of patch cords and adherence to performance standards is critical to the reliable operation of a high-speed LAN.

4.4.5 Fiber Optic Cable

This Standard specifies laser-optimized Optical Multimode (OM) OM4- and OM5-rated Multimode (MM) fiberoptic cable primarily for ISP use.

OM4 is primarily used to support single-pair 10 GbE, four-pair 40 GbE or ten-pair 100 GbE, access-layer to aggregation or core layers. Typical intra-building backbone between TRs and

MDAs will consist of a minimum of two diversely routed 24-strand cable assemblies from both A- and B-side MDAs and two 12-strand Single-mode (SM) cables to both A and B as required by the LAN baseline.

OM5 is designed to support Short Wavelength Division Multiplexing (SWDM) where switch transceivers can support 40 Gigabit per second (Gb/s) and 100 Gb/s on two fibers. OM5 is included in this Standard for specialized data center applications only.

In backbone distribution, field selectable OS1 or OS2 SM 12/24-strand fiber optic cable assemblies using Multi-fiber Push On (MPO) connectors are specified. Typical intra-building backbone between TRs and MDAs will consist of a minimum of two diversely routed 12-strand cable assemblies for path diversity from both A and B MDAs as required by the LAN baseline. However, if intra-building distances exceed the OM4 limit and only SM is used, then two 24-strand cable assemblies are required.

OS2 12/24-strand indoor/outdoor rated assemblies SM fiber optic cable is primarily used for OSP and long-distance transmission for requirements exceeding the capabilities of MM fiber. Additionally, it is necessary for some special systems and for intra-building as well as inter-building connectivity. Typical inter-building backbone will consist of a minimum of two diversely routed 24-strand cable assemblies from both A and B MDAs as required by the LAN baseline. Where separate buildings are serviced with SM fiber, each TR in that building requires the minimum redundant SM cable distribution.

Factory pre-termination is the preferred termination method, but field-termination is acceptable for work area distribution applications and where pre-termination is impractical such as in horizontal distribution from TRs. Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation.

If fiber media is required for horizontal distribution to WAO, a structured approach is required. A stated need for fiber to work WAOs should be scrutinized by the planner and justified by sound technical requirements. This application must be approved in writing by DCIE via a variance request.

Table 32: Fiber Optic Cable Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Multimode	Performance Category	• OM4 (horizontal and backbone) • OM5 (specialized data center applications)
		Performance Specifications	Laser Optimized 50/125 µm fibers with minimal effective modal bandwidth of 4,700 MHz·km at 850 nm

ID	Primary Attribute	Secondary Attribute	Specification
		Combustion Rating	• Communications Riser (CMR) rated for vertical runs through floors • Communications Plenum (CMP) rated for plenum spaces • Communications (CM) minimum jacket rating suitable when riser or plenum are not required • Or as per AHJ requirement
		Jacket Color	Refer to the TIA standard
		Termination Method	• Factory pre-terminated (computer room structured cabling use) • Field terminated (connections between telecommunications spaces)
		Media Connector	LC/Angled Physical Contact (APC), Ultra Physical Contact (UPC), or as required by application
		Strand Count	• 12 or 24 per assembly • Constructed in strand bundles of 6 or 12 for compatibility with specified splice cassettes
		Cable Length	Cables not to exceed 6 ft (2 m) of excess length on each end
		Bundling	Dielectric, Tight Buffered
		Polarity	• Straight (or Type A-Key up one end & key down on the other) • Type B with “universal” cassettes
2	Single Mode	Performance Category	OS1/OS2 to be field selectable)
		Performance Specifications	Laser Optimized 9/125 µm with effective modal bandwidth of at least 850 MHz·km at 1310 nm

ID	Primary Attribute	Secondary Attribute	Specification
		Combustion Rating	• Riser cable for vertical runs through floors • Plenum rated for plenum spaces • Tight-buffered for OS1 • Loose-tube gel-filled for OS2 riser rated when used for OSP indoor/outdoor transition • Or as per AHJ requirement
		Jacket Color	Yellow
		Termination Method	• Factory pre-terminated (computer room structured cabling use) • Field terminated (connections between telecommunications spaces)
		Media Connector	MPO or LC (application dependent)
		Strand Count	• 12 or 24 per assembly • Constructed in strand bundles of 6 or 12 for compatibility with specified splice cassettes
		Cable Length	Cables not to exceed 6 ft (2 m) of excess length on each end
		Bundling	Dielectric • Tight-Buffered – ISP Use • Loose-Tube Gel-Filled – OSP Use
		Polarity	• Straight (or Type A-Key up one end & key down on the other) • Type B with “universal” cassettes

Evaluation Factors

- Warranty
- Performance category tuned to match all channel components
- OM4 performance characteristics for up to 10 GbE intra-building backbone
- OM5 performance characteristics for data center distribution for specialized application
- SM performance characteristics for vertical backbone OS1 or OS2 to be field selectable for inter-building backbone and OSP
- Combustion rating requirements
- Technical requirements for inclusion in horizontal distribution to the WAO

Implementation Guidance

Dual 24-strand OM4 50/125 MM and dual 12-strand field selectable OS1/OS2 SM per TR with path diversity will support most small/medium capacity distribution needs. Some larger TRs may require additional fiber counts.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation.

This Standard specifies the polarity of horizontal pre-terminated MPO-based fiber optic cabling as Type A (straight-through) or Type B with 'universal cassettes' for LC cassette breakout. If a polarity flip for the channel is necessary, use a Type A/A patch cord on one end and a Type A/B patch cord on the other end. In some cases, an A/B cord can be converted to an A/A by switching the connector position on one end of the patch cord. Type C polarity is not authorized.

There should be two simultaneous A/B redundant, diverse distribution paths minimally to all TRs in clinical spaces. Diverse path routing is also required for the service provider circuits to diverse entrance rooms and within the data center between the equipment distributors and HDAs, and between the HDAs and the MDAs. Path diversity to administrative spaces should have diverse distribution paths wherever possible. Where not possible, media should not be in the same conduit.

MPO-8 cassettes for SR4 should be planned directly with the distribution designer or DCIE.

See Sections 4.4.1 and 5.3.2 on cable routing and implementation.

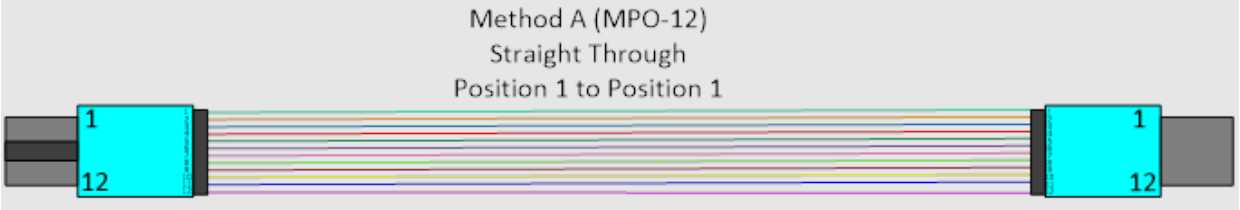

Figure 23: Method A Polarity of Horizontal Pre-terminated MPO-based Fiber Optic Cabling

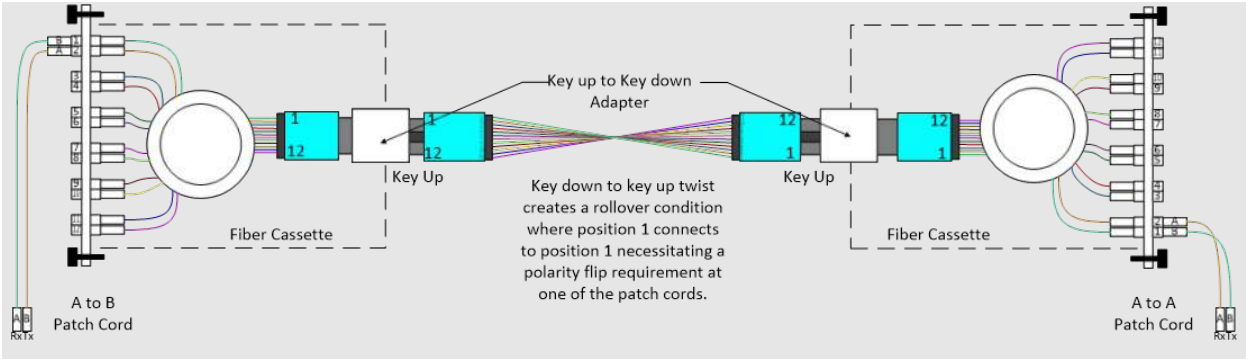

Figure 24: Method A Polarity End to End Connectivity (A-B and A-A Patch Cords Required)

4.4.6 Fiber Distribution Cassettes

This Standard specifies the transition component of the structured cabling system for fiber optic cabling in telecommunication spaces. It is the fiber equivalent to UTP patch panels. This Standard specifies 12/24-strand, OM4- or OM5-rated MM cassettes for ISP and use SM cassettes for SM applications. The cassette will be equipped with dual, 12-strand or single 24-strand MPO interfaces as the backbone or horizontal interface.

Table 33: Fiber Distribution Cassettes

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Form Factor	1 RU
		Capacity	3-12 cassettes
		User Interfaces	LC connectors (6/12 duplex per cassette) MPO connectors (8 fibers)
		Backbone Interfaces	12-strand or 24-strand MPO (50 micron)
		Type	OM4 Laser Enhanced 10 GbE or OM5 Laser Enhanced 50/125 Multimode to match media

Evaluation Factors

- Performance category tuned to match all channel components
- Performance characteristics
- Form factor
- Interfaces
- Channel installations (including cassette equipment on each end) certified to Tier I and Tier II performance standards

Implementation Guidance

This Standard specifies Optical Multimode-4 and -5 (OM4 and OM5) rated 850 nm laser-enhanced multi-cable fiber cable assemblies pre-terminated with MPO connectors. One cassette will be used to provide LC interfaces at both ends of the horizontal or backbone link and will support one or two 12-strand cable assemblies or one 24-strand cable assembly for a total capacity of 6 or 12 duplex LC interfaces. Cassettes can also be used to breakout 24-strand MPO backbone trunks into three MPO connections of eight fiber strands.

4.4.7 Fiber Patch Cords

This Standard specifies high-bandwidth, factory pre-terminated fiber patch cords. The standard media interface for fiber patch cords is duplex LC. Patch cord polarity requirements can be accommodated by specifying a polarity-reversible duplex interface or by using universal cassettes. When polarity requirements are not known, the polarity-reversible duplex LC interface should be specified.

Table 34: Fiber Patch Cord Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Performance Category	• OM4 • OM5 (used only for specific data center applications (see Section 4.4.1))
		Performance Specifications	Laser enhanced, 50/125 MM fiber, Duplex LC
		Jacket Color	Refer to TIA standard
		Termination Method	Factory pre-terminated
		Polarity	• Type A/A (Straight) or • Type A/B (Crossover) as required

Evaluation Factors

- Performance category tuned to match all channel components
- Polarity reversibility
- Performance specifications

Implementation Guidance

ISP design best practices dictate that component-level compliance to a performance standard must be maintained across the entire horizontal link. The quality of patch cords and adherence to performance standards is critical to the reliable operation of a high-speed LAN or SAN.

The polarity of the fiber optic channel may need to be flipped depending on the application. This will ensure that the equipment sending or transmitting will be connected to the receiving port of the equipment at the other end. If typical A/B fiber patch cords are used on both sides of the channel, continuity may be lost. As shown in Figure 25 below, this is corrected by either switching the connector position of both strands at one end of the patch cord or by using a Type A/A patch cord on only one end of the channel.

Pre-termination requires that distances between termination points are known; however, it assures maximum performance and rapid installation.

See Sections 4.4.1 and 5.3.2 on cable routing and implementation.

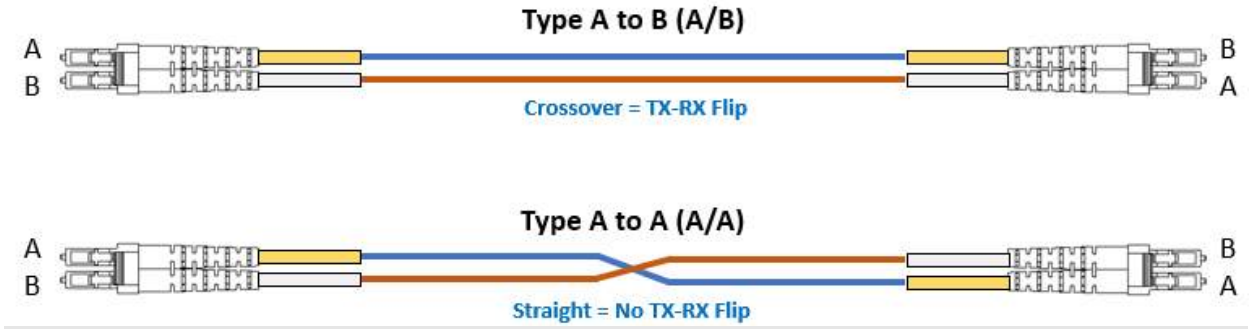

Figure 25: Polarity of Fiber Optic Patch Cord

4.4.8 Fiber Distribution Panel/Cabinet

This Standard specifies a one RU panel for mounting fiber cassettes. The smallest form-factor has been selected for application flexibility.

Table 35: Fiber Distribution Panel/Cabinet Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Performance Characteristics	Form Factor	1 RU
		Cassette Capacity	3-12 cassettes
		Type	• Cabinet • Panel

Evaluation Factors

- Form factor
- Cassette capacity
- Locking requirements

Implementation Guidance

ED Fiber Distribution Panels will be installed in the top RU (RU44 or RU45) of each server cabinet where required.

4.4.9 Cable Support Infrastructure

This Standard creates uniform high-capacity horizontal and vertical cable management for Cat 6A patch cords.

Table 36: Cable Support Infrastructure Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Horizontal Cable Management Panels	Form Factor	• 1 RU (up to 50 Cat 6A patch cords) • 2 RU (up to 100 Cat 6A patch cords)
		Cover	Double-hinged
		Finger Spacing	To meet requirements; typically, 6-port spacing (five fingers)
2	Vertical Cable Management Panels	Door	Double-hinged
		Dimensions	6 in. to 16 in.

Evaluation Factors

- RU Finger spacing
- Double-hinged cover capacity

Implementation Guidance

Vertical cable management will be utilized for the HDA and the MDA. Horizontal cable management within the rack will be utilized as necessary to encourage defined and traceable routing of individual patch cords from switches to the vertical cable managers.

4.4.9.1 Cable Distribution

This Standard offers consistency in the construction characteristics of overhead cable tray to achieve common mounting, hanging, support, bonding, and interconnecting features for the benefit of data center and ITS designers and end-users.

Network cable distribution should be distributed in overhead cable trays in all new installations when overhead space allows. Existing underfloor cable trays will be phased out during major upgrades to existing data centers and ITS.

Table 37: Cable Distribution Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Cable Tray	Design	Wire Basket
		Capacity	• Maximum fill ratio not to exceed 50 % • Depth of telecommunications cables not to exceed 6 in.
		Bonding Kit	Mechanically bond cable pathway sections and trays to one another and to the Supplemental Bonding Network in accordance with ANSI/TIA-607-D
		Clearance	• 2 in. from top of cable tray to bottom of access floor in legacy underfloor installation • 6 in. clearance between cable trays in stacked overhead installations • Media types will be segregated
		Installation	Per manufacturer's recommendations
		Intended Use	Applications in the horizontal (X,Y) plane
2	Fiber Raceway	Design	Rigid plastic, modular, nominally 4 in. x 4 in.
		Intended Use	Applications in the horizontal (X,Y) plane in MSCs, CSCs, and CDCs
		Installation	Per manufacturer's recommendations
3	Ladder Rack	Design	12 in. width steel or aluminum ladder with stringers and cross members
		Intended Use	Applications in the vertical (Z) plane
		Installation	Per manufacturer's recommendations

Evaluation Factors

- Wire-basket construction
- Toolless joining kits
- ASTM coating

Implementation Guidance

Cable pathways shall meet the clearance requirements of fire detection, suppression, and prevention systems, and these systems must be coordinated with other systems (e.g., electrical, mechanical, telecommunications) and meet the requirements of the manufacturer and the AHJ.

Cable tray in MSC, CSC, and CDC facility classifications is intended to support UTP distribution only, with fiber optic distribution to be in fiber optic raceways.

If both power and telecommunications cabling are distributed from below the access floor, then:

- The power cabling should be routed either adjacent to or within the cold aisle
- The telecommunications cabling should be routed adjacent to or within the hot aisle
- Power and communication pathways should be positioned at different heights off the floor so that they can cross each other without interference. Alternatively, at every point where the power and copper cabling cross the path of each other, the crossing should be at a right (90-degree) angle

4.4.10 Work Area Outlets

Work Area Outlets (WAOs) are user interfaces to the cabling system within a workspace, floor, or building. Each telecommunications outlet/receptacle connected by media to a patch panel in the supporting TR is considered a single WAO, so a faceplate at an end-user location may typically have two WAOs.

This Standard specifies the typical quantity and type of faceplate, wall box, conduit, and outlets for typical administrative work areas. However, this guidance does not preclude variations based on atypical capacity requirements nor does it supersede guidance or requirements set forth by CFM concerning WAO specifications for specialized spaces.

Typical in-wall work boxes shall be a single-gang telecommunications-rated work box with rigid conduit extending to the horizontal pathway.

Floor boxes shall be single-gang or "poke-thru" type. Cable that extends through a slab penetration shall terminate in the nearest practicable TR on the same serving floor.

The typical standard density work area telecommunications data faceplate will consist of two RJ45 interfaces (two WAOs). This provides both redundancy and support for future equipment requirements. IP phone systems used in VA shall have gigabit throughput capabilities and be connected in-line between the WAO and workstation. This allows the workstation to interface with the network via the phone base at the full planned bandwidth of the horizontal channel media and leaves one RJ45 at the faceplate available for future use.

Evaluation Factors

- Serving zone capacity requirements
- Special safety, desktop support, or medical device requirements

Implementation Guidance

WAO media interfaces shall be tuned to the horizontal media, specified to the same performance rating, and installed according to best practices.

No RJ-11 "phone outlets" are specified in this Standard. A second gang with outlets for analog telephony purposes are acceptable.

Single-outlet posted faceplates shall be configured with one RJ45 interface. The high-density WAO configuration consists of four RJ45 interfaces. This configuration is typically used for desktop support and other technical staff or in cases where multiple devices need network access from the same WAO.

4.4.11 Horizontal Distribution

Horizontal distribution is defined as structured cabling that connects the WAO or the equipment distributor to a horizontal distributor. The horizontal distributor will be located in the end of row HDA in a computer room or in a TR depending on the application.

Horizontal media shall be specified per Section 4.4.1. If the application, such as a data center, requires fiber, specify the media per Section 4.4.5.

4.4.12 Fiber Optic Backbone Distribution

Backbone distribution is defined as structured cabling that connects the horizontal distributor to the Main Distributor (MD). The MDA will be located in a centralized location within the building, data center, or LAN serving area. Typically, this will be in the computer room.

The A-side and B-side MDAs shall be separate and distinct telecommunications spaces within the LAN serving area. It is preferred that the MDAs are built in separate locations, but they can be combined into one space. The MDAs shall not be located in a TR.

Campus fiber optic backbone distribution shall be diversely routed to each TR and entrance room from the A/B redundant MDAs. Administrative and healthcare buildings require full backbone diversity and redundancy as described. Buildings with strictly craft, maintenance, or service purposes (e.g., laundry, physical plant, trade shop) may be supplied with a single backbone path.

This Standard only recognizes 50/125 Laser-Enhanced Multimode (OM4 and OM5) and 9/125 Single Mode (OS1 and OS2) as acceptable backbone media (see Section 4.4.5).

UTP shall be utilized only if fiber media cannot serve specialized applications such as legacy phones, fax machines, or security panels. Where copper backbone is required, this Standard specifies quantity two riser-rated Cat 5e, 25-pair cables to be installed between the TR HDA and the MDA. This approach will support 12 patch panel positions. One 12-position Cat 6 patch panel shall be installed in the HDA and the MDA. Individual 4-pair Cat 6 riser-rated cables may be used, but this approach is not recommended and will require technical review by DCIE.

Criteria requirements for diverse path backbone:

- Supports VA clinical staff function in a healthcare setting
- Supports VA clinical-supporting staff function with end-user desktop and/or VOIP phone requirement
- Supports VA administrative staff function with end-user desktop and/or VOIP phone requirement (reduced fiber count routing may be considered if space cannot be used for a healthcare/clinical function, e.g., Washington DC administrative buildings, VBA regional office buildings)
- Not required for patient-only areas without any VA staffing function presence (non-diverse and reduced fiber count routing may be considered)
- Not required for VA technician, maintenance, or trades areas or facilities (non-diverse and reduced fiber count routing may be considered)

4.4.12.1 Intra-building

4.4.12.1.1 Multimode

This standard specifies Laser Optimized 50/125 OM4 required for new installations to meet single-pair 10 GbE objective.

Replace or retrofit the following legacy cable:

- Laser Optimized 50/125 (OM3 is exempted; OM4 for all tech refresh projects required)

- 62.5 core (OM1) – replace
- Non-optimized (OM2) – replace

4.4.12.1.2 Single Mode

This standard specifies 9/125 field selectable OS1 or OS2 MPO for intra-building SM application.

SM may be required for backbone distribution in support of specialized applications, such as DAS.

4.4.12.2 Inter-building

Inter-building backbone shall not transition at an intermediate cross-connect. Therefore, the MDA will connect directly to each TR in all campus buildings outside of the computer room building.

For all inter-building connectivity, 9/125 indoor/outdoor rated OS2 SM fiber will be utilized. when paths are outside of MM range and not connected by environmentally protected conditioned spaces.

4.4.13 Copper Backbone Distribution

Copper backbone is intended to provide the broadest amount of flexibility in supporting analog telephony, single-pair ethernet, building automation, and other, non-ethernet future applications. Copper backbone replaces Cat 3 legacy station cabling and the Main and Intermediate Distribution Frames (MDFs and IDFs) used for analog and POTS telephony distribution, as the sunset of local-loop copper-based infrastructure and replacement of Private Branch Exchange (PBX) telephone systems with VoIP systems require modern approaches and equipment.

Install non-redundant Cat 5e-rated 25-pair 24 AWG copper backbone from a Main Distribution Area (MDA) in the facility computer room to each distributed TR on the campus. Install additional backbone to TRs where the TR's serving zone is identified to require more than 24 connections. Install a minimum of two each 25-pair trunks between the computer room and the entrance room where POTS lines demarcate from the service provider.

Copper backbone and equipment is specified to be rack-mounted (as opposed to wall-mounted) on each end allowing direct patching to horizontal media and future systems.

Typical termination will use pins 4 and 5 of the RJ45 connector, following the T568B standard (solid/striped). Terminate the first port of each 24-port patching element with pins 3, 4, 5, and 6 to connect the 'extra' backbone pair.

4.4.13.1 Intra-building

Terminate backbone to 24-port UTP patch panels at the TR end and 48-port UTP patch panels at the computer room end.

Lightning surge protection is required at the facility antenna entrance room where transients could be generated and transmitted back to the computer room.

4.4.13.2 Inter-building

Terminate backbone to 24-port UTP patch panels on both ends.

Lightning surge protection is required when copper backbone transits OSP pathways that could expose the conductors to electrical transients. For copper backbone applications where surge protection is required, use only flat (not angled) 24-port patch panels. Adjacent to each 24-port UTP patch panel requiring protection, install 1U rack-mount 24-position surge protector equipment.

4.4.14 Server Cabinets

VA designs and implements telecommunications spaces fully built out with IT equipment enclosures, power, cooling, and structured telecommunications cabling. Install all IT equipment in these standard enclosures following the VA structured cabling model.

Because of this design philosophy, during post-commissioning lifecycle, vendor-provided server cabinets, wall-mounted enclosures, and similar are not required and are not accounted for in telecommunications space layouts intended for "roll-in" spaces for future vendor-provided enclosures. Do not plan, specify, order, or install additional vendor-provided enclosures for installation into the master-planned, built-out data center.

These specifications define a standardized server enclosure with sufficient depth to accommodate active hardware and cable management.

Table 38: Server Cabinet Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Dimensions	Height	7.5 ft maximum
		Width	• 24 in. • 30 in. permitted in groups of four to maintain alignment with floor tiles in raised floor environments only
		Depth	48 in. nominal with all doors and accessories installed
		Rack Units	44/45
2	Design	Rails	• Square-punched (two pair = front + rear) • Toolless adjustable • Rear rails installed with not less than six in. clearance to inside of rear cabinet doors to accommodate ED patch panels
		Rack Marking	Present on front and rear rails graduated starting with RU1 from the bottom
		Static Capacity	2,500 lb minimum

ID	Primary Attribute	Secondary Attribute	Specification
		Color	White or existing match
		Bonding Connection	Doors, frame, and side, top, and bottom panels
		Green Technology	Heat containment per data center cooling architecture
3	Panels	Front Door	Single perforated (minimum 63 % open)
		Rear Door	• Single or split solid when VEDs are used, or • Split, perforated where VEDs cannot be implemented
		Latches	Keyed lock upgradable to keyless system compression latch
		Top	• VEDs (heat containment) required in facilities equipped with overhead return air ducting systems • High-capacity cable access w/brushes
		Side	• Solid • Locking
		Bottom	• Solid • With high-capacity cable access w/ brush grommets or air dam foam in raised access floor locations
4	Required Accessories	Air Dam and Sealing Kit	Required under each cabinet and between rails and cabinet sides
		Castors	Required for safe cabinet movement
		Leveling Legs	Required
		Baying Kit	Required to keep cabinets aligned
		Grounding	• RBC • Bonded in accordance with ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises • Tagged with “Do Not Disconnect” See Section 4.2.9 for specific requirements and guidance
		rPDU brackets	Zero U vertical single mount brackets for SD cabinets Double mount brackets for HD cabinets

Evaluation Factors

- Dimensions
- VEDs/heat containment
- Available RUs
- Grounding equipment and bonding

Implementation Guidance

This Standard specifies green technology in the form of heat containment. This approach to thermal management does have corresponding data center design requirements and, therefore, should be selected based on the cooling architecture of the target data center.

Server cabinets with VEDs shall be specified and provided for deployment to computer rooms with overhead return air ducting systems installed. In facilities with these supply/return air separation systems, cabinets shall be specifically designed to match the needs of the engineered environmental control system. Where a provider wants to install a non-standard cabinet, re-racking of equipment into a standard cabinet is required.

Where required by VA Seismic Design Requirements (H-18-8), enclosures require seismic restraint by bracing, anchorage, or similar practice. Rear rails of server cabinets shall be set not less than 6 in. from the rear door(s) of the cabinet to allow space for rear-mounted angled patch/distribution equipment in the Equipment Distributor and to accommodate up to four vertical rPDUs in high density applications.

Active networking equipment shall not be installed in server cabinets. This includes fabric interconnects, fabric extenders, and other types of equipment (e.g., TOR switches) used for network distribution, even when part of a 'converged' system. Except for in authorized wall-mounted TEs, active networking equipment shall only reside in designated network racks and network cabinets (HDAs and MDAs in data centers), using structured cabling systems to distribute network services to IT equipment in server cabinets. White server cabinets are specified for reduced energy absorption and increased reflectivity for improved visibility. Black servers, switches, patch panels, blanking panels, and other equipment makes it difficult for technicians to work within a dark cabinet due to the low light levels.

Cabinet height of 7.5 ft maximum is required to leave room for structured cabling, power busbars, containment systems, fires suppression, etc. A larger cabinet does not provide an advantage because the limiting load factor is the power and heat rejection capability of the cooling systems, not rack space. A taller cabinet also makes the equipment difficult to access without a ladder.

4.4.15 Network Equipment Racks

Table 39: Network Equipment Racks

ID	Primary Attribute	Secondary Attribute	Specification
1	Dimensions	Height	7.5 ft maximum
		Width	24 in. nominal minimum
		Depth	30 in. minimum
		Rail Style (Front/Rear)	• EIA threaded or • Square punched
		Rack Units	44/45
2	Design	Style	Channel rack
		Static Capacity	2,000 lb minimum
		Cable Management	Built-in overhead waterfall and cable management strap attachment points
		Rail Marking	Present on front and rear rails graduated starting RU number one at the bottom-most position
		Color	White or existing match
3	Required Accessories	Grounding	• Rack Bonding Busbar (RBB) • Bonded in accordance with ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises • Tagged with "Do Not Disconnect" See Section 4.2.9 for specific requirements and guidance
		rPDU	rPDU brackets
		Side Air Intake Scoops	Required for racks with side-to-side airflow equipment

Evaluation Factors

- Dimensions
- Cable management capacities
- Available accessories for horizontal and vertical cable management
- Grounding equipment and bonding
- Static capacity
- Locking front or rear doors
- Side air intake scoops

Implementation Guidance

Racks and network equipment cabinets shall be used for all networking gear to include the MDA and the HDA.

Racks are mandatory for use in TRs.

Two-post and four-post (open wall) racks are prohibited for use in VA telecommunications spaces. Replace all existing racks with specified network equipment (channel) racks or network cabinets (depending upon the application). This Standard specifies a deep channel open rack to accommodate the depth and weight of most data networking equipment while providing high capacities for horizontal cable and large diameter Cat 6A patch cords.

White racks are specified for reduced energy absorption and increased reflectivity for improved visibility. Black networking equipment, patch panels, blanking panels, and other equipment makes it difficult for technicians to work within a dark rack due to the low light levels.

Server cabinets shall not be used in place of network racks due to inherent cable management limitations. Specifically designed network cabinets greater than 30 in. wide may be used in place of network racks if the proper cable management accessories are installed.

Where required by VA Seismic Design Requirements (H-18-8), enclosures require seismic restraint by bracing, anchorage, or similar practice.

4.4.16 Network Equipment Cabinets

Table 40: Network Equipment Cabinet Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Dimensions	Height	7.5 ft maximum
		Width	• 30 in. minimum • 40 in. maximum and preferred
		Depth	48 in. nominal with all doors and accessories installed
		Rack Units	44/45
2	Design	Rails	• Square-punched (2 pair = front + rear) • Toolless adjustable
		Rack Marking	Present on front and rear rails graduated starting one RU from the bottom
		Static Capacity	2,500 lb minimum
		Color	White or existing match
		Bonding Connection	Doors and frame
		Green Technology	Heat containment per data center cooling architecture
3	Panels	Front Door	Single or double perforated (minimum 63 % open)
		Rear Door	• Split solid when VEDs are used, or • Split, perforated where VEDs cannot be implemented
		Latches	Keyed lock upgradable to keyless system compression latch
		Top	• VEDs (heat containment) required in facilities equipped with overhead return air ducting systems • High-capacity cable access w/brushes
		Side	• Solid with brush sealed cable openings to allow for horizontal distribution • Vertical cable management • Locking
		Bottom	• Solid • With high-capacity cable access w/ brush grommets or air dam foam in raised floor environments

ID	Primary Attribute	Secondary Attribute	Specification
4	Required Accessories	Air Dam and Sealing Kit	Required under each cabinet and between rails and cabinet sides
		Castors	Required for safe cabinet movement
		Leveling Legs	Required
		rPDU brackets	Zero U vertical single mount brackets
		Grounding	• RBC bonded in accordance with ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises • Tagged with "Do Not Disconnect" • See Section 4.2.9 for specific requirements and guidance
		Baying Kits	Required to keep cabinets aligned

Evaluation Factors

- Dimensions
- VEDs/heat containment
- Available RUs
- Grounding equipment and bonding

Implementation Guidance

This Standard specifies green technology in the form of heat containment. This approach to thermal management does have corresponding data center design requirements and, therefore, should be selected based on the cooling architecture of the target data center.

Network equipment cabinets with VEDs shall be specified and provided for deployment to computer rooms with overhead return air ducting systems installed. In facilities with these supply/return air separation systems, cabinets shall be specifically designed to match the needs of the engineered environmental control system. Where a provider wants to install a non-standard cabinet, re-racking of equipment into a standard cabinet is required.

Where required by VA Seismic Design Requirements (H-18-8), enclosures require seismic restraint by bracing, anchorage, or similar practice.

White network cabinets are specified for reduced energy absorption and increased reflectivity for improved visibility. Black networking equipment, patch panels, blanking panels, and other equipment makes it difficult for technicians to work within a dark network cabinet due to the low light levels.

Cabinet height of 7.5 ft maximum is required to leave room for structured cabling, power busbars, containment systems, fires suppression, etc. A taller cabinet does not provide an advantage because the limiting load factor is the power and heat rejection capability of the

cooling systems, not rack space. A taller cabinet also makes the equipment difficult to access without a ladder.

4.4.17 Telecommunications Enclosure Layout Standards

Telecommunications Enclosures (TE) are permitted for use in non-clinical spaces in lieu of standard TRs when meeting the established criteria. They are not permitted in clinical spaces.

Table 43: Telecommunications Enclosure Layout Standards

ID	Primary Attribute	Secondary Attribute	Specification
1	Cabinet	Construction	• NEMA-12 or equivalent • Tempered glass front door • Dust seals and replaceable inlet/outlet vents/airflow openings/fans
		Access	• Cabinet swings open to access rear of installed equipment • Swinging front door to access front of installed equipment • Both sections able to be physically locked
		Racking Rails	EIA-310-D 19 in. front and rear adjustable
		Height	• 12 RU (horizontal distribution only) • 26 RU (main distribution area function only)
		Width	24 in. minimum
		Mounting	16 in. on-center for standard stud construction
2	Outfitting of TEs	Input Power	A/B redundant L5-30 120 V 20 A circuits
		UPS	• Rack-mounted 2880 VA metered L5-30 input/output • Dual/delta conversion not required • Connected to A-side input power circuit
		Rack Power Distribution	• A/B redundant 1 RU horizontal rPDUs • L5-30 input; minimum eight 5-15R outlets
		Heat dissipation	120 V fans
		Fiber Backbone	• 1 RU fiber distribution cabinet • Flat cabinet authorized

ID	Primary Attribute	Secondary Attribute	Specification
		Horizontal Distribution	• 1 RU UTP patch panels • Flat patch panels authorized • Maximum one patch panel for 12 RU TE; two patch panels for 26 RU TE
		Network Switches	• Standard 1 RU 48-port network switches • Maximum one switch for 12 RU TE; two switches for 26 RU TE
		IT Equipment Power Cord Type	• 120 V 15 A • C13 at IT equipment power supply and NEMA 5-15 at rPDU
		IT Equipment Power Cord Color Code	• A-side: Black • B-side: A distinctly different color (white or gray preferred) • Differentiated by source bus (jacket or other marking) • Comply with any established local color schema
		Bonding	Standard equipment and interconnections as per a TR and network channel rack

Evaluation Factors

- Installation environment
- Rack Unit count required for horizontal distribution
- Number of WAO served
    - Network switch count requirement
    - Patch panel count requirement
- Access locks for both front and rear access
- Grounding equipment and bonding

Implementation Guidance

A maximum of 96 WAOs can be supported by a standardized TE. Each data jack in a workspace telecommunications outlet, wired back to the patch panels in the TE, is considered a WAO for these purposes.

- Where 1-48 WAOs are planned, a 12 RU (half-height) standardized TE is used
- Where 49-96 WAOs are planned, a 26 RU (full height) standardized TE is used

No services other than VA LAN horizontal distribution can be supported from a standardized TE, except in a building with no VA staffing presence and no requirements for VA LAN but where guest WiFi is provided.

TEs may be deployed to spaces falling within the environmental envelope conditions for a TR, as described in Figure 19 and Figure 24 of the ISTS. Ambient air conditions in the space are between 41 °F - 95 °F dry bulb, 8 % - 80 % RH, and a dew point less than 82.4 °F. In healthcare facilities, the more restrictive requirements of the HVAC Design Manual must be met.

Non-standard environmentally conditioned TEs may be approved by variance for use in spaces where the ambient air conditions extend outside of these limits.

All knockouts and cable entry points shall be sealed to prevent liquid and dust entry.

Accessories include cable port brush kit, low-noise dual fan and filter kit, replacement filter kit, shelves, vertical rail-mounted cable managers, and LED light kit.

Non-diverse pathways for backbone media may be served by a single TE, but the pathway must still contain redundant fiber backbone media (both A/B backbone elements present).

Criteria requirements for diverse path backbone:

- Supports VA clinical staff function in a healthcare setting
- Supports VA clinical-supporting staff function with end-user desktop and/or VOIP phone requirement
- Supports VA administrative staff function with end-user desktop and/or VOIP phone requirement (reduced fiber count routing may be considered if space cannot be used for a healthcare/clinical function, e.g., Washington DC administrative buildings, VBA regional office buildings)
- Not required for patient-only areas without any VA staffing function presence (non-diverse and reduced fiber count routing may be considered)
- Not required for VA technician, maintenance, or trades areas or facilities (non-diverse and reduced fiber count routing may be considered)

5 Administration Standards

These specifications are intended to allow complete and consistent identification and physical location information for VA data center and computing facilities, physical plant and distribution equipment supporting VA data center facilities, equipment located within the VA data center environment, and the component types and elements described for use in physical and logical information management systems describing the connectivity of physical elements present in the data center environment.

Identification specifications are based on the current version of ANSI/TIA-606-C, with modifications for the VA operating environment.

5.1 Data Center Position Identification

The purpose of this specification is to establish guidance for identifying physical locations for equipment and components in the VA data center environment. This specification contains instruction for uniform identification of equipment and component locations used at telecommunications spaces across the enterprise.

Specifically, because of the legacy nature of VA facilities, no single facility location system is implemented enterprise-wide. Individual VA locations (i.e., VAMCs) have developed and implemented individual location identification methodologies that are beyond the scope of this document. Telecommunications spaces within VA facilities shall follow the location identification guidance herein.

Table 41: Data center Position Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Data Center Floor Grid Location Identification	Alignment	Aligned with plan North in building drawings
		Location Origin	Northwest corner
		Location Increments	• Two-foot increments with alphanumeric identification • Begin at the appropriate designator such as A1 for first full floor tile, depending on number of tiles in the data center • Increase letters from left to right • Increase numbers from top to bottom
		Variance/Waivers	Required but granted automatically if existing (legacy) system is compatible

Evaluation Factors

Each data center uses a compliant grid identification scheme allowing detailed location identification of physical equipment.

Implementation Guidance

Data center layouts shall be master-planned. Equipment layouts can be adequately defined by location in the data center master floor plan. This location identification scheme shall be applicable to all enterprise data centers, existing and new. Individual facilities shall apply for a variance if there is an existing location schema differing from the one stated. Variance for compatible legacy systems will be approved automatically in the DCIM system of record for facilities with an approved variance. A characteristic watermark or similar shall be assigned to the plan view to indicate a non-standard layout.

While some buildings are built to align with true north, many are not – but the architectural plans for all facilities will have a "Plan North," aligned with the top of the drawing. This specification assumes that data center access floor grids will align with Plan North.

The ANSI/TIA-606-C standard initiates the computer room location system at the top left (plan NW) corner of the computing floor space. The access floor grid (where used) shall be alphanumeric with tile location A1 (*depending on data center size; see below*) denoting the (plan) northwestern-most full tile on the floor. For grid location identification purposes, beginning with alphanumeric tile location A01, letters shall increase across the X-axis (left to right) from A to Z, or from AA to AZ, then BA to BZ, and so on. Numbers shall increase down the Y-axis (top to bottom) from 1, or 01, onward (spreadsheet orientation). Representative examples of grid identification are shown below for reference.

If a facility has more than 26 tiles on the X-axis, use AA as the starting location (rather than A) to allow sorting in database tools. For example, AA through AZ, then BA through BZ – do not start with A through Z in these larger facilities. If the data center has:

- Fewer than 10 tiles on the Y-axis, then use "A1-A9."
- 10 or more tiles on the Y-axis, then use "A01-A99."
- 100 or more tiles on the Y-axis, then use "A001-A999."
- The same follows for the X-axis where "A1-Z1" are used for 26 tiles or fewer in the Y-direction, and "AA01-ZZ01" are used for data centers with over 26 tiles in the Y-direction.

Where an irregular arrangement of the facility means that there is no tile in what would typically be the A1 position, label floor tiles from this location using 2-foot increments. This system is of use in designating equipment locations for non-standard raised floor items, including CRAC units and larger storage or mainframe units. Note that there may be partial tiles around the first full tile(s) in any row or column that are not numbered in this system.

In data centers operated without an access floor grid, apply stenciled grid crosshairs at 24-inch centers to the floor (where the crosshair locations are accessible). The crosshairs should extend in each cardinal direction at least 4 in. and 4 in. on each axis). Note that the grid need not begin in the physical corner of the room and may be moved a simulated 'partial tile' in to better align with installed equipment.

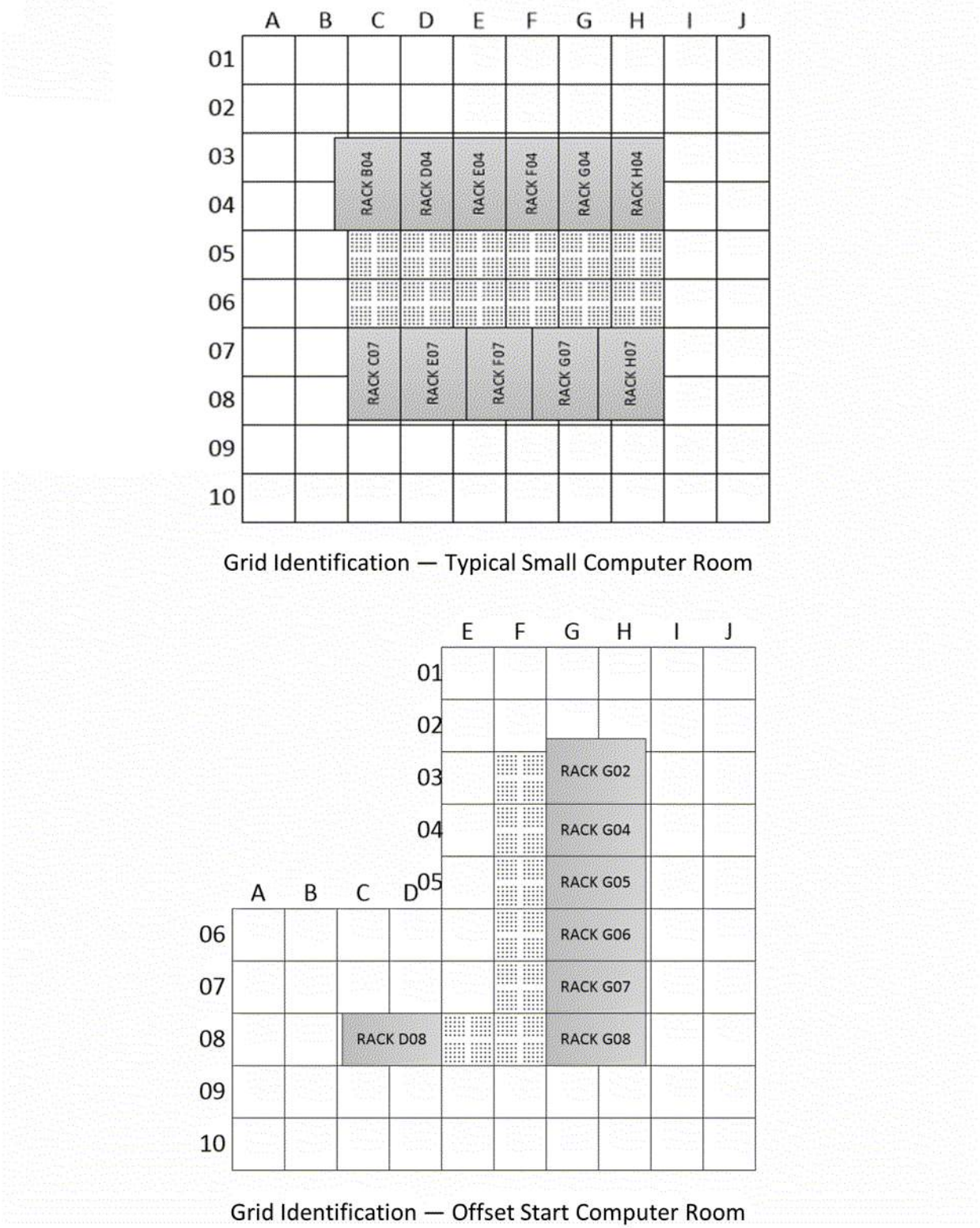

Figure 26: Typical Position Identification Examples

Identification of individual computer spaces within a single building depends upon the configuration of those spaces. Where access floor spaces are adjacent and use the same grid (i.e., rooms separated by partition walls for security or other isolation purposes), both spaces shall use the same grid beginning with the A01 tile in the northwestern-most space. Where access floor spaces are separated and/or are based on separate grids (i.e., one room in one portion of a building and the other in a different portion), each space shall use individual grids, each starting with its own A01 tile.

Grid identification within each data center space shall be posted to allow occupants to understand their current location. Post location identifiers on walls, columns, and/or from hanging tags as necessary to allow occupants to reasonably determine all grid locations. Identifiers shall be a minimum of 4-inch high characters, semi-gloss black lettering, with top of character not more than 6 inches below ceiling, concrete slab, truss line or typically accepted physical divider between workspace and ceiling line.

Items on the floor shall be noted as being located at locations in accordance with ANSI/TIA-606-C, meaning the grid location of the tile containing the left front corner of the item (when facing the front of the item). If the item has no identifiable front, the first full tile covered closest to the grid origin shall be the location identifier.

5.1.1 Cross-Reference to Other Identification Systems

Nothing in the DCIM specification is designed or intended to conflict with any other mandatory standard(s) affecting the VA data center environment.

VA information management tools such as DCIM, BAS, and Computerized Maintenance Management Systems (CMMS) shall include database fields (where applicable) to identify the standardized location identifier (and other location identifiers) as specified herein These fields are not intended to supplant or replace other identification numbers already in use by other systems.

5.1.2 Standardized Data Center Facility Type Identification

Data centers across VA generally support the local mission and are tailored to the mission of the local office. This leads to multiple types of (and names for) the facilities, which must be standardized to ensure that the intent of using a facility's name is clearly understood.

The list of FACILITYTYPE attributes is intended to align with (but will not be replaced by) the data center classification schema described in Section 2 as VA undergoes further transformation and data center consolidation activities.

Evaluation Factors

- Each data center is classified as a single FACILITYTYPE.
- All data centers are classified as a FACILITYTYPE on the current FACILITYTYPE list.
- Use of FACILITYTYPE is consistent in OIT-standardized data structures.

Implementation Guidance

The FACILITYTYPE attribute describes at a high-level what type of facility the data center supports, the specific mission of the facility, or what type of information is processed by the data center.

The FACILITYTYPE list is maintained by NDCOL and is anticipated to be simplified as the enterprise completes transformative data center consolidation activities.

Classify all data center facilities as exactly one of the facility types in the list below. Computer room facilities in VAMCs, whether OIT, CE, facility management service, R&D, or otherwise, are classified as VAMCs in the FACILITYTYPE list.

FACILITYTYPE names shall only consist of three or four alpha characters and not contain ampersands, numbers, or other special characters to prevent issues with DCIM systems or other database queries.

*Table 42: Standard FACILITYTYPE Naming Conventions – Campus Support Centers (CSC)**

FACILITYTYPE	Description
VAMC	VA Medical Center
OPC	Large Outpatient Clinics
CBOC	Large Community-Based Outpatient Clinics
HCC	Health Care Center

** There are some specific instances of overlap between CDCs and VAMC facilities (e.g., Cleveland, Temple) as the data centers in these locations operate both as CSCs and also provide or are designed and built to meet the intent of operation as a CDCs.*

Table 43: Standard FACILITYTYPE Naming Conventions - Mission Support Centers (MSC)

FACILITYTYPE	Description
CMOP	Consolidated Mail Outpatient Pharmacy
CPAC	Consolidated Patient Account Center
OIFO	Office of Information Field Office
HEC	Health Eligibility Center
NCPS	National Center for Patient Safety

FACILITYTYPE	Description
PBM	Pharmacy Benefits Management Office
ALC	Acquisition Logistics Center
CSP	Cooperative Studies Program
HSRD	Health Services Research & Development Center

Table 44: Standard FACILITYTYPE Naming Conventions - Network Support Centers (NSC)

FACILITYTYPE	Description
NSC	Network Support Center (generic if no other designation is appropriate)
CBOC	Typical size Community-Based Outpatient Clinics (CBOC)
VARO	VBA Regional Office
VRE	Vocational Rehabilitation & Employment Center
RMC	Records Management Center

5.1.3 Standardized Data Center Naming Convention

Facility legacy and common names are not standardized and do not yield sufficient clarity on where an OIT-operated or OIT-supported computer or telecom space is located, what its function is, or what the intended mission supported by the facility or space is, in the context of VA's data center strategy.

Evaluation Factors

- Each data center is assigned a single standardized data center name.
- Use of CITYNAME is consistent in OIT-standardized data structures for all data center facilities.
- Use of FACILITYTYPE is consistent in OIT-standardized data structures for all data center facilities.

Implementation Guidance

The basic Standardized Data Center Name is formatted as [CITYNAME FACILITYTYPE]. The master naming list for Standardized Data Center Names shall be maintained by NDCOL.

The CITYNAME attribute is intended to be the physical municipality in which the site or facility is primarily located which is unique from other municipality names in use and is the most discrete and descriptive. This field is qualitative depending on the mission and function of the type of VA facility; for example, the new VAMC supporting the Denver, CO metropolitan area is actually located in Aurora, CO, but the CITYNAME will be Denver.

Although the VAMC supporting Augusta, ME, is located in Togus, ME; because Augusta, GA is the more commonly known metropolitan area, the Georgia facility will be assigned CITYNAME Augusta, while the Maine facility will be assigned CITYNAME Togus.

The FACILITYTYPE attribute describes at a high-level what type of facility the data center supports, the specific mission of the facility, or what type of information is processed by the data center. The available types align with the data center classification archetypes. As classes of facilities are simplified and collapsed through data center consolidation efforts, this list may be revised.

A site or facility will be referred to by its "standard name" where possible. Where there is more than one reportable computer room at a single site or facility, both computer rooms share the same "standard name" and are differentiated using its OMB assigned DCOI facility ID number. This naming convention includes the ability to identify all OIT computer support spaces (computer rooms, TRs, non-OIT computer rooms, and similar) uniquely, drilling down from the site or facility 'standard name' with additional record fields as described. Due to the wide variety of legacy configurations at individual facilities, additional detailed guidance on how to linguistically identify these individual spaces is not provided.

Example: The fictional VAMC in MyTown is classified as a Campus Support Center for the hospital campus; its standardized data center name is MyTown CSC. There are other IT support spaces on the campus supported by this CSC, including a biomed server room that is determined to not be able to be consolidated to the main data center, two main TRs servicing remote buildings on campus, auxiliary TRs servicing other floors in the remote buildings, and auxiliary TRs servicing different wings and floors of the main hospital building. All these spaces are considered hierarchically under (attached to) the MyTown CSC. They are specifically identified by building number and room number; for example, MyTown CSC, Bldg 3, Rm 3-102.

Not all computing support spaces will be assigned a Standardized Data Center Name. All computing support spaces, from computer rooms to TRs to non-reportable rooms containing IT equipment that requires IT or physical environment management, shall be assigned a VA Record ID number, separate from the DCOI-assigned facility ID number. The VA Record ID numbers shall be of the format "VA-YYYYY," where YYYYY is a unique five-digit number. VA Record ID numbers are not intended to be sequential, either at time of assignment or in the future. ID numbers are assigned at the enterprise data warehouse level by NDCOL and distributed by the NDCOL DCIM team.

Example: MyTown CSC is assigned DCOI facility ID number DCOI-99999. The VA Record ID number for the reportable data center is VA-12345, and the TRs supporting two-story remote building 3 are VA-34201 and VA-58456. The TRs, -34201 and -58456, are supported by the reportable data center but are not assigned a DCOI facility ID number.

Example: A fictional National Cemetery has a computing support space, operating a router connecting the facility with the VA wide area network. NCA spaces do not operate data centers. This facility will not be assigned a Standardized Data Center Name or DCOI facility ID number but will be assigned a VA Record ID number, VA-56789.

Where a computing support space is directly supported by a data center with a DCOI facility ID number, include record field information that the space is supported by that data center, indicating the hierarchical arrangement. Not all computing support spaces are located in facilities with a data center, or directly supported by a facility subject to the standardized naming convention. Assign these spaces a VA Record ID number; they will be further identified by their physical address and having blank record field information where the standard name and DCOI facility ID number of the supporting facility would otherwise be recorded.

The legacy (or official) site or facility name shall be retained and record fields available in all databases and systems to cross-reference the standardized name with the legacy name. An example of a legacy name that may not be sufficiently descriptive is "John J Pershing VAMC." Without additional information, the location of this facility could be in doubt.

5.2 Information Transport Systems Equipment and Component Labeling

The purpose of this specification is to establish guidance for labeling physical locations, equipment, and components in the VA data center environment congruent with the identification specifications in this Standard.

This specification contains instruction for uniform and appropriate labeling of data center and ITS equipment at VA data center facilities. Applications include:

- Identifying and labeling new systems when installed
- Re-labeling existing systems as field verification documentation is generated
- Uniform labeling of equipment and components used at data processing facilities across the enterprise

5.2.1 Label Materials

Materials for labeling purposes are not specifically defined in this Standard. Use materials appropriate to the purpose, intent, environment, and equipment being labeled.

5.2.1.1 Approved Materials

Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

5.2.1.2 Unapproved Materials

Materials which can be lost, damaged, rendered unreadable, easily removed, soiled or degraded by operating environment, or which are of a non-permanent nature shall not be used for labeling or identification purposes. This includes (but is not limited to) paper, paper in clear plastic protectors, and direct labeling of equipment and components with markers or paint.

Table 45: Information Technology Systems Equipment and Component Labeling Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Equipment Labeling	Attachment	Permanent
		Position	• Readily visible • Horizontal orientation where feasible • Top right corner of equipment faceplate where feasible • Shall not interfere with operation of labeled equipment
		Materials	• Appropriate for the installation environment • Durable and permanent • Heat resistant in high-temperature areas
		Coloration	Not specified
2	IT Equipment Rack/Cabinet Labeling	Governing Industry Standard	ANSI/TIA-606-C, NFPA 70
3	Data Communications Cabling Labeling	Labeling Requirements	Floor Grid Location
		Label Location	Top right front door, top right back door, top right front inside cabinet, top right back inside cabinet
		Governing Industry Standard	ANSI/TIA-606-C
		Label Location	Both ends of all installed cables and cords
		Coloration	Following local site schema

ID	Primary Attribute	Secondary Attribute	Specification
4	Power Distribution Labeling	Governing Industry Standard	ANSI/TIA-606-C, NFPA 70
		Label Location	• Both ends of all installed cords • Within 36 in. of leaving distribution panel enclosure • Within 12 in. of the point-of-use end of conduit
		Coloration	• No enterprise specification is prescribed • Colors shall be used to differentiate electrical bus power sources

Evaluation Factors

- All equipment and components are labeled as specified
- Labeling is done in a legible, professional manner
- Facility location systems are in place in the data center environment
- Power distribution is labeled appropriately from end-to-end and uses bus color scheme allowing rapid visual identification

Implementation Guidance

Data center equipment and components shall be labeled per operational requirements before being designated operable or in service.

- Labels shall be permanently attached and designed to withstand wear, erosion, and corrosion.
- Position labels so they are readily visible and, where feasible, oriented in a horizontal position. Where feasible, labels should be placed near the top right corner of permanently installed equipment faceplates. Labels shall be legible without manipulation by site personnel. Although not recommended, vertical orientation may be used only where space is limited. Vertical orientation shall be read from top to bottom.
- Labels or tags installed under this specification shall not interfere or alter existing manufacturer's nameplate or code information. Labels described in this specification are intended for identification within the local facility and are not expected to support or substitute for asset management labeling.
- Labels shall be located to eliminate any possible confusion as to the item being identified and shall not obscure other items nearby.
- Labels shall not interfere with an operator's ability to read the instrument, display, or gauge, or to operate the equipment.
- Labels shall be mounted in such a way as to preclude accidental removal.
- Labels shall be mounted on a flat surface, if possible.
- Use ANSI/TIA-607-D identifier scheme for telecommunications bonding and grounding system elements.

- Use compatible terms in ISO/IEC 30129 for all new construction or renovation.

For existing infrastructure, labels using legacy terms from earlier revisions of ANSI/TIA-607-D are exempted until routine tech refresh, lifecycle replacement, upgrades, new installations, or renovations of existing space.

5.2.2 Support Infrastructure Identification

This section identifies equipment support elements covered under this Standard. Equipment support elements are passive components such as racks and cabinets that serve to house or mount both passive and active components such as patch panels or servers.

Table 46: Support Infrastructure Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Equipment Support	Row	Label: **ROW-xxx** **ROW** designates row **xxx** is a sequential number (pad number of digits in designator (x, xx, xxx) to match the total number) Example: **Row 01**
		Rack/Cabinet (Final)	Label: **RK-aann** • **RK** designates rack (or cabinet) labeled left to right when looking at the front of the rack • **aa** is the alphabetic portion of the floor grid location (pad number of digits in designator (a, aa) to align with the number of floor location tiles in the plan E-W axis) • **nn** is the numeric portion of the floor grid location (pad number of digits in designator (n, nn, nnn) to match the total number) Example: **RK-AM45**
		Rack/Cabinet (Design Phase Only)	Label: **RK-nnxxx** • **RK** designates rack (or cabinet) labeled left to right when looking at the front of the rack • **n** is the numeric row designator (pad number of digits in designator (n, nn) to match the total number of rows) • **xxx** is a sequential number (pad number of digits in designator (x, xx, xxx) to match the total number) Example: **RK-101** *Note: These will be converted to alphanumeric locations upon physical installation for sustainment.*

ID	Primary Attribute	Secondary Attribute	Specification
		Pathway Rack (Final)	Label: **PRK-aann** • **PRK** designates pathway rack, which is a small enclosure (typically five RU) that is generally attached to an overhead cable tray assembly above an IT equipment rack or cabinet for the purposes of terminating structured cabling to a patch panel in the pathway rack • **aa** is the alphabetic portion of the floor grid location (pad number of digits in designator (a, aa) to align with the number of floor location tiles in the plan E-W axis) • **nn** is the numeric portion of the floor grid location (pad number of digits in designator (n, nn, nnn) to match the total number) Example: **PRK-AM45**
		Pathway Rack (Design Phase Only)	Label: **PRK-nnxxx** • **PRK** designates pathway rack, which is a small enclosure (typically five RU) that is generally attached to an overhead cable tray assembly above an IT equipment rack or cabinet for the purposes of terminating structured cabling to a patch panel in the pathway rack • **n** is the numeric row designator (pad number of digits in designator (n, nn) to match the total number of rows) • **xxx** is a sequential number (pad number of digits in designator (x, xx, xxx) to match the total number) Example: **PRK-101** *Note: These will be converted to alphanumeric locations upon physical installation for sustainment.*
		Rack Unit	Label: **ru** • **ru** is the RU number present (stamped or painted) on front and rear rails corresponding to the bottom left corner of the item in the rack or server Example: **SERVER AD02-35** with 35 indicating the RU.
2	Cable Tray	Not Defined	Not Defined

ID	Primary Attribute	Secondary Attribute	Specification
3	Cable Management Panels	Horizontal	Label: **CMH-aann-ru** • **CMH** designates cable management panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU in which the panel is installed Example: **CMH-AM45-30** (cable management panel at position RU30 in rack or cabinet AM45)
		Vertical	Label: **CMV-aann-aann; CMV-aann-L; CMV-aann-R** • **CMV** designates cable management panel • **aann-aann** designates rack or cabinet identifiers, left-to-right, viewed from front, between which panel is installed • **L** or **R** designates on which side of rack panel is installed, as viewed from front of rack, if not installed between racks Example: **CMV-AM45-AM46** (cable management panel is between racks or cabinets AM45 and AM46)

5.2.2.1 IT Equipment Cabinet/Rack Location Identification

Use the modified ANSI/TIA-606-C compatible labeling format with cabinet/rack grid location and cabinet/rack RU position (format xy-ru) to identify IT equipment, switch, patch panel, and similar equipment locations. Equipment location in IT equipment racks shall be identified by the bottom RU that the equipment occupies (e.g., a four-RU height server position occupying positions 36-39 is located at RU position 36). VA-standard IT equipment racks have 44 or 45 RU of spaces for racked equipment. RU numbering shall begin at the bottom-most mounting space and increase upwards (one RU is 1.75 in. in height, and the numbering is typically printed on the mounting rails).

In the example shown in Figure 27 below, the server in IT equipment rack AD02 that occupies spaces 27 and 28 RU from the bottom of the rack would be identified with location AD02-27.

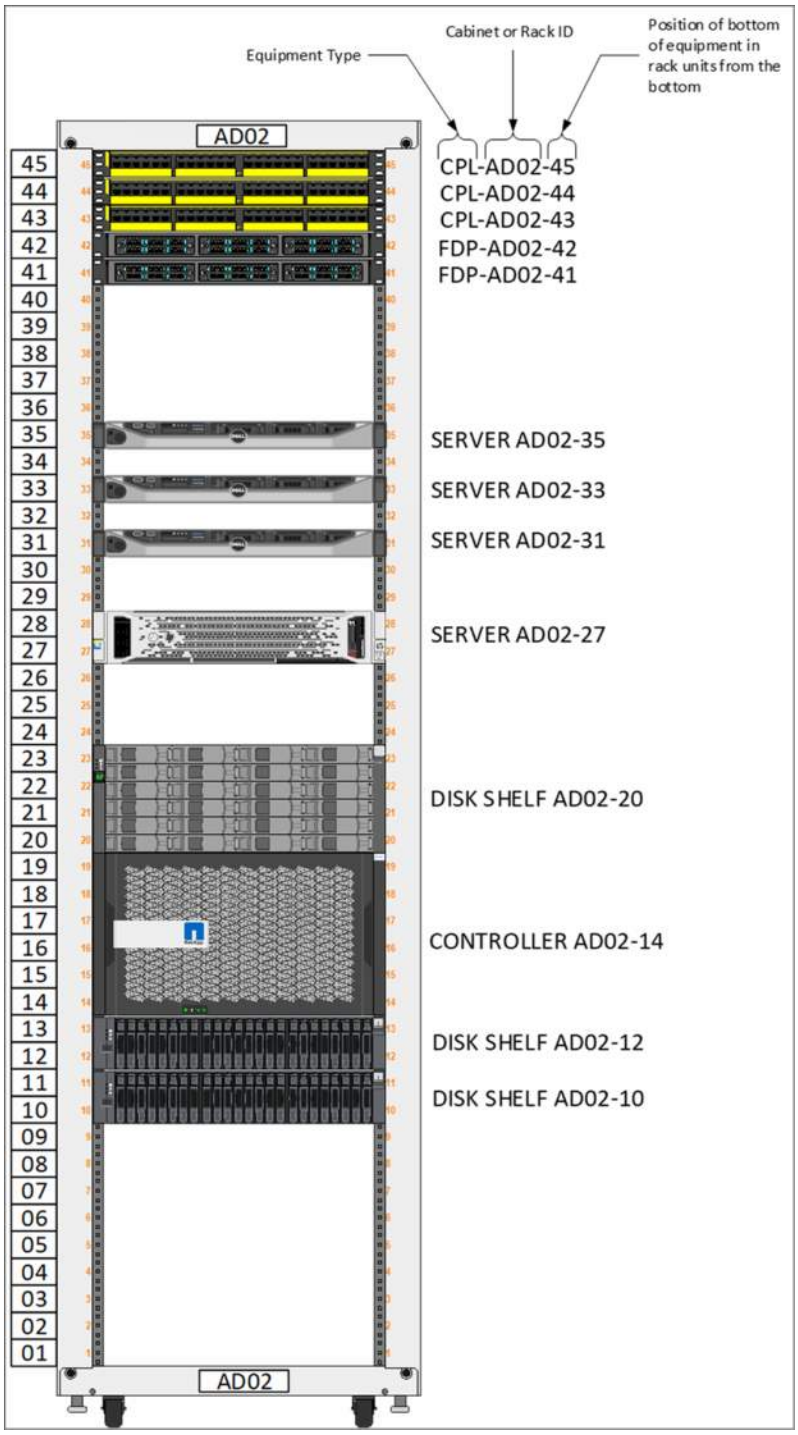

Figure 27: Rack Unit Identification Example

5.2.3 Transport Media and Interface Identification

This section identifies transport media and associated elements covered under this Standard. Transport media includes, but may not be limited to, all horizontal and vertical (backbone) cabling and patch cords. Associated elements include, but may not be limited to, patch panels and fiber termination elements.

Table 47: Transport Media and Interface Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Patch Panel	UTP	Label: **CPL-aann-ru** • **CPL** designates UTP patch panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU in which installed Example: **CPL-AM45-40** (patch panel installed in RU40 in rack, cabinet, or pathway rack AM45) *Note: **aann-ru** may be utilized as the sole label designator (without CPL). The fully qualified name is intended to support reporting activities through a physical layer asset management system.*
		UTP Patch Panel Position	Label: **CPL-aann-ru.xx** • **CPL** designates UTP patch panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU the panel is installed • **xx** is the position number as identified by the patch panel stamped label Example: **CPL-AM45-AA.24** (position 24 in the patch panel designated as AA in rack, cabinet, or pathway rack AM45) *Note: **aann-ru.xx** may be utilized as the sole label designator. The fully qualified name is intended to support reporting activities through a physical layer asset management system.*
2	Fiber Distribution Termination Hardware	Fiber Distribution Panel/Cabinets	Label: **FPL-aann-ru** • **FPL** designates fiber distribution panel • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU the distribution panel is installed Example: **FPL-AM45-30** (fiber cabinet at position RU30 in rack or cabinet AM45)

ID	Primary Attribute	Secondary Attribute	Specification
		Fiber Distribution Cassette	Label: **FCS-aann-ru.L** • **FCS** designates fiber distribution panel cassette • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU in which the FCS is installed. • **L** designates the fiber distribution cabinet/panel slot location ID numbered from left to right starting at 1 Example: **FCS-AM45-40.2** (the cassette in slot location two of FCS in RU40 in rack or cabinet AM45)
		Fiber Distribution Cassette Interface Position	Label: **FCS-aann-ru.L.xx** • **FCS** designates fiber distribution cassette interface position • **aann** designates installed location by rack or cabinet identifier • **ru** is the RU in which the FDC is installed • **L** designates the fiber distribution cabinet/panel slot ID • **xx** is the position identifier as labeled on the cassette. If a label is not available, then use (L) for the left MPO and (R) for the right MPO Example: **FCS-AM45-40.2.05** (position five in the cassette in slot two of FCS installed in RU40 in rack or cabinet AM45), alternately **FCS-101-40.2.L**
3	Cable (Data Communications)	Bulk Unshielded Twisted Pair (UTP)	Label: **UTP[aann-ru.yy]/[aann-ru.yy]** • **UTP** designates unshielded twisted pair • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the patch panel RU designator • **yy** is a two-digit number corresponding to the patch panel position Example: **UTP[AM45-42.24]/[AAR15-03.24]** UTP connecting position 24 in patch panel located at RU42 in rack AM45 to position 24 in patch panel located at RU03 in pathway rack AR15

ID	Primary Attribute	Secondary Attribute	Specification
		Pre-terminated Cable Assemblies (UTP)	Label: **UTP[aann-ru]/[aann-ru].nn-mm** • **UTP** designates unshielded twisted pair • **aann** designates terminal locations by rack or cabinet identifier • **ru** designates RU in which installed • **nn-mm** are two numbers that identify the start and end ports to be connected by the bundle Example: **UTP[AM45-AA]/[AR15-AB].01-06** UTP bundle connecting patch panel AA located in rack AM45 to patch panel AB in rack AR15 port 01 to port 06 (inclusive)
4	Fiber Cable (Data Communications)	Pre-terminated Cable Assemblies (Multi-mode)	Label: **FMM[aann-yy.L]/[aann-yy.L]** • **FMM** designates fiber optic cabling, multimode • **aann** designates terminal locations by rack or cabinet identifier • **yy** is a numeric fiber distribution cabinet/panel identifier per rack or cabinet • **L** designates the fiber distribution cabinet/panel cassette or slot ID and the left or right MPO connector Example: **FMM[AM45-03.2L]/[AR15-03.2L]** Multi-mode cable assembly connecting cassette two, left MPO in FCS 03 located in rack AM45 to cassette two, left MPO in FCS 03 located in rack AR15
		Pre-terminated Cable Assemblies (Single-mode)	Label: **FSM[aann-yy.L]/[aann-yy.L]** • **FSM** designates fiber optic cabling, single mode • **aann** designates terminal locations by rack or cabinet identifier • **yy** is a numeric fiber distribution cabinet/panel identifier per rack or cabinet • **L** designates the fiber distribution cabinet/panel cassette or slot ID and the left or right MPO connector Example: **FSM[AM45-03.2R]/[AR15-03.2R]** Multi-mode cable assembly one connecting cassette two, right MPO in FCS 03 located in rack AM45 to cassette two, right MPO in FCS 03 located in rack AR15

ID	Primary Attribute	Secondary Attribute	Specification
5	Patch Cords	UTP	Label: **CCA[aann-ru.xx]/[aann-ru.xx]** • **CCA** designates UTP patch cord • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU location of the patch panel or device • **xx** is the port or visually identifiable network interface card ID to which the end of the patch cord is connected Example: **CCA[AM45-44.12]/[AR15-30.2]** UTP patch cord connecting patch panel 44 position 12, located in rack AM45 to IT equipment port 2, located in RU position 30, rack AR15
		Modular Plug Terminated Link (MPTL) for security cameras, WAPs, and other PoE equipment	Label: **CCA[aann-ru.xx]/[CAMxxx]** or **[WAPxxx]** or **[aann-RPDU.s(.x)]** • **CCA** designates UTP patch cord • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU location of the patch panel or device • **xx** is the port or visually identifiable network interface card ID to which the end of the patch cord is connected • **CAM** designates camera (by local site camera naming convention) • **WAP** designates wireless access point (by local site WAP naming convention) • **RPDU** designates RPDU. For RPDUs, the .s is either A or B indicating the side, and the (.x) is either 1 or 2, only used for HD cabinets Example: **CCA[AM45-44.12]/[AR15-CAM118]** UTP patch cord connecting patch panel 44 position 12, located in rack AM45 to IT camera 118

ID	Primary Attribute	Secondary Attribute	Specification
		Fiber Optic	Label: **FCA[aann-ru.xx]/[aann-ru.xx]** • **FCA** designates fiber patch cord • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU location of the patch panel or device • **L** designates the fiber distribution cabinet/panel slot location ID numbered from left to right starting at 1, then from top to bottom (see explanatory diagram in implementation guidance below) • **xx** is the port or visually identifiable network interface card ID to which the end of the patch cord is connected Example: **FCA[AM45-44.2.06]/[AM45-24.2]** Fiber patch cord connecting patch panel in RU44, cassette in slot 2, port 06, located in rack AM45 to IT equipment port 2, located in RU position 24, rack AM45

Implementation Guidance

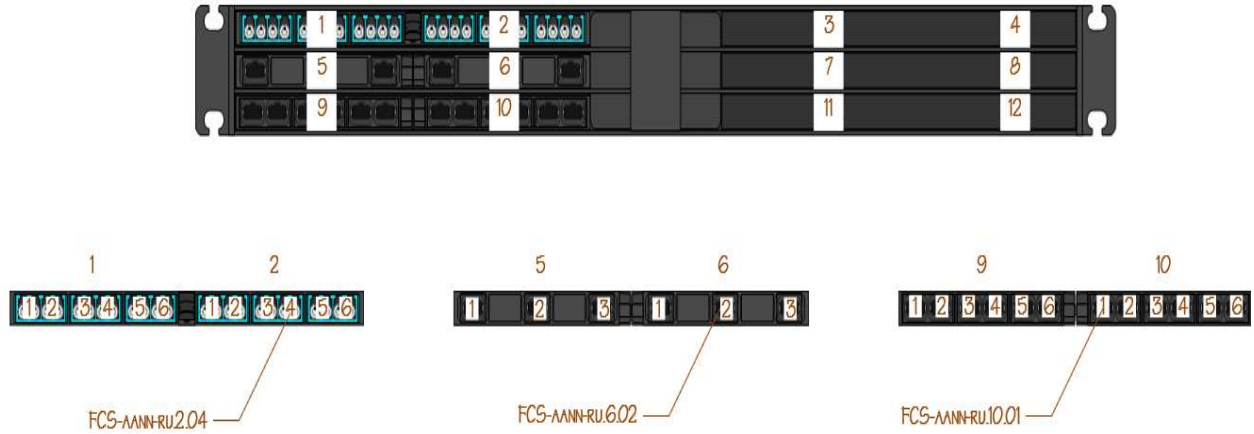

Figure 28. Fiber Panel Slot Location ID Numbering Example

5.2.4 Power Distribution Identification

This section identifies power distribution components and associated elements covered under the ISTS. Power distribution includes, but may not be limited to, active and passive facilities equipment that transfers electricity from source equipment and panels to the terminal receptacles on rack-mounted power distribution assemblies. Associated elements include, but may not be limited to, PDUs, distribution panels, power whips, and in-rack power distribution systems.

Identification of power distribution is limited to physical location of the equipment and not to power chain relationships. Power chain relationships will be elaborated upon in a future standard revision.

Table 48: Power Distribution Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Power Distribution Source (data center level)	Power Distribution Unit (PDU)	Label: **PDU-xxxx** • **PDU** designates Power Distribution Unit • **xxxx** is the host name matching the VA naming convention for networked PDUs within the facility or local naming convention for non-networked PDUs. In facilities with multiple (A/B) bus distribution to the IT equipment, local naming conventions should indicate which bus the power is supplied from. Example: **PDU-3A**
		Remote Distribution Cabinet (RDC)	Label: **RDC-xxxx** • **RDC** designates a Remote Distribution Cabinet, which is a stand-alone expansion distribution panel unit fed from a sub-feed breaker in a PDU • **xxxx** is the local naming convention for the RDC within the facility. The typical RDC designator will be a sub-designation of the parent PDU, i.e., RDC-3A-1 indicates an RDC fed from sub-feed breaker 1 on PDU3A Example: **RDC-3A-1**
		Distribution Panel (DP)/ Branch Circuit Panelboards (BCP)/ Remote Power Panels (RPP)	Label: **DP-xxxx** • **DP** designates a wall-mounted distribution panel fed from an upstream DP, sub-feed breaker in a PDU, or other similar source • **xxxx** is the local naming convention for the DP within the facility Example: **DP-CR3A** *Note: Naming conventions for DPs at the facility or data center level are not specified.*

ID	Primary Attribute	Secondary Attribute	Specification
		Busway	Label: **BUS-xxxx** • **BUS** designates an overhead power distribution busway, which is a ceiling-mounted conductor enclosure fed from an upstream distribution panel, sub-feed breaker in a PDU, or other similar source, to which individual 'taps' with integral power whips are attached • **xxxx** is the local naming convention for the busway within the facility Example: **BUS-ROW3** *Note: Busways are typically associated with rows of IT equipment*
		Power Tap	Label: **TP[ELEMENT1]/[ELEMENT2]** • **TP** designates a power tap off a power busway system • **ELEMENT** components select the source (ELEMENT1) and powered item (ELEMENT2) using nomenclature described elsewhere in this specification. Many combinations of taps are possible using this designation depending upon the specific power distribution schema used in individual data center facilities. Example: **TP[BUS-xxxx]/[RPDU-aann.gl.zn]** *Note: There are two busways per row in a small data center so a busway element example would be [BUS-03A] or [BUS-03B] to identify the 03 A- or B-busway. However, in larger data centers there are multiple pods in rows along each line. In that case BUS-03A1, BUS-03A2, etc. will identify which pod along the 03 line is specfied.*
2	Power Distribution Source (rack/enclosure level)	Zone Power Distribution Unit (zPDU)	Label: **ZPDU-aann.ru** • **ZPDU** designates a Zone Power Distribution Unit, which is a rack-mounted unit allowing A/B distribution to standard and HD power distribution topologies • **aann** designates terminal locations by rack or cabinet identifier • **ru** is the RU where a horizontal ZPDU is installed in the rack or cabinets viewed from the rear of the rack Example: **ZPDU-AM45.03** is a horizontal ZPDU installed in rack AM45 at RU position 03

ID	Primary Attribute	Secondary Attribute	Specification
		Subzone Vertical Rack Power Distribution Unit (rPDU)	Label: **RPDU-aann.gl.zn** or **RPDU-aann.aann.gl.zn** • **RPDU** designates Rack Power Distribution Unit, which is a distribution power strip that power cords from terminal IT equipment plug into • **aann** designates terminal locations by rack or cabinet identifier • **gl** is the group and leg designation as labeled on the zPDU outlet connected to the rack-mounted PDU • **z** designates left or right (L or R) mounting of the PDU • **n** is the number of the PDU starting at the rear of the rack Example: **RPDU-AR16.A2.L2** is the second power strip mounted on the left of the rack connecting to the zPDU's A bus in rack • **RPDU-aann.yx.zn** (Alternative, when no zPDU is present, ie., direct connection from rPDU to a power whip from a DP, RDC, or PDU) -y designates the power bus to which the rPDU is connected. Where there is a single bus supporting a space, the bus is denoted as "A". Multiple busses will be "A" and "B". • **-x** designates the number of the rPDU, in that rack, on that bus. The first rPDU in the cabinet on the bus is number 1, the second 2, and so on. If no zPDU is present (direct connection from the rPDU to a power whip from a DP, RDC, or PDU), this refers to the power strip. Example: **RPDU-AR16.A2.L1** is the second power strip on the A Bus, and is the first power strip on the Left side in the rear of cabinet AR16 Example: **RPDU-AR18.B1.R2** is the first power strip on the B Bus, and is the second power strip on the Right side in the rear of cabinet AR18

ID	Primary Attribute	Secondary Attribute	Specification
3	Power Distribution (conductors)	Power Whips	Label: **WHIP[ELEMENT1]/[ELEMENT2]** • **WHIP** designates a set of electrical conductors in a conduit or other flexible power cord assembly intended to move electricity from a distribution point to a point-of-use component • **ELEMENT** components select the source (ELEMENT1) and powered item (ELEMENT2) using nomenclature described elsewhere in this specification. For example, they may be written as [PDU-xxx.aa,bb,cc]/[ZPDU-aann.ru]. Many combinations of whips are possible using this designation depending upon the specific power distribution schema used in individual data center facilities. • **aa,bb,cc** is the set of circuit breaker positions used at the source end corresponding to the positions in the breaker panel, if applicable. For whips beginning at a busway tap, do not use the .aa,bb,cc portion of the designator Example: **WHIP[PDU-3A.13,15,17]/[ZPDU-AR14-03]** Power whip connecting three-pole circuit breaker in positions 13, 15, and 17 in PDU-3A to zPDU in rack AR14 located at position RU03
		Power Cords (from rPDU to IT Equipment)	Not Defined

5.2.4.1 IT Equipment In-Rack/In-Cabinet Power Distribution Labeling

Rack power information shall be labeled on each individual vertical rPDU, on the frame behind the door, front and back, as well as on the doors, front and back. Machine-printed paper tags secured with clear plastic or acetate adhesive tape are the minimum standard for these tags. Hand written labels of any type are not permitted.

Alternative IT equipment (non-rack based) shall be labeled with physical location (grid identification) and power distribution sources and with any additional identifying information needed to identify that specific piece of equipment. Install power designator labels near or on the power cord leaving the equipment. Place equipment location tags on the front top, or at location associated with the first full tile closest to the origin.

5.2.4.2 Power Distribution to IT Labeling

Data center power distribution components such as breakers, switches, receptacle junction boxes, and IT equipment power circuits ("whips") shall be labeled with approved machine generated adhesive tape, cable tags or other approved method. Hand written labels of any type are not permitted.

All non-IT power distribution in the data center space should be labeled in the same manner to ensure a safe environment. All electrical equipment which is served by, or which contains multiple sources of power, shall comply with NFPA 70 standards to identify both disconnecting means.

The source end of each whip shall be labeled within 3 ft of the conduit leaving the distribution panel enclosure. The point-of-use end of each whip shall be labeled on the junction box, on the connector, or within 1 ft of the end of the conduit.

Labels installed internal to electrical or electronic components shall not provide a ground or short circuit path or interfere with the operation of components.

5.2.5 Data Communications Cabling Labeling

The Administration Standards specify use of ANSI/TIA-606-C compatible formats for identifying data communications cabling. (More complicated installations may require reference to that document.) Data communications cabling (UTP, fiber, and other) shall be labeled on both ends with information about the network port that it connects to on each end. Machine-printed paper tags secured with clear plastic or acetate adhesive tape are the minimum standard for these tags as in Figure 29 below. Handwritten labels of any type are not permitted.

Figure 29: Example of Communications Cable Labeling

IT equipment (including switch and patch panel) network ports shall be individually identified from manufacturer information, typically provided in equipment drawings available for integration with rack elevation drawings and a DCIM tool. Where not otherwise provided, cardinally number ports along the top row from left-to-right, then along the next row down from left-to-right, and so forth.

Equipment ports and the cables in each (if any) are denoted by the equipment position with the additional identifier xx. Thus, a cable end will be labeled in VA-modified ANSI/TIA-606-C compliant format [aann-ru.xx].

To identify the connected path of each data communications cable, the physical position identifiers at both ends are needed. The label for each cable shall identify the near side (NS) location and the far side (FS) location in VA-modified ANSI/TIA-606-C compatible format (e.g., "NS/FS"). Therefore, a UTP patch cord going from AD02-35 port 10 to patch panel BD02-19 port 04 would be identified (on the near end) as CCA[AD02-35.10]/[BD02-19.04], and labeled (on the far end) as CCA[BD02-19.04]/[AD02-35.10]. Automated systems adopted within VA shall understand the reciprocal relationship in these identifiers as representing a single connection.

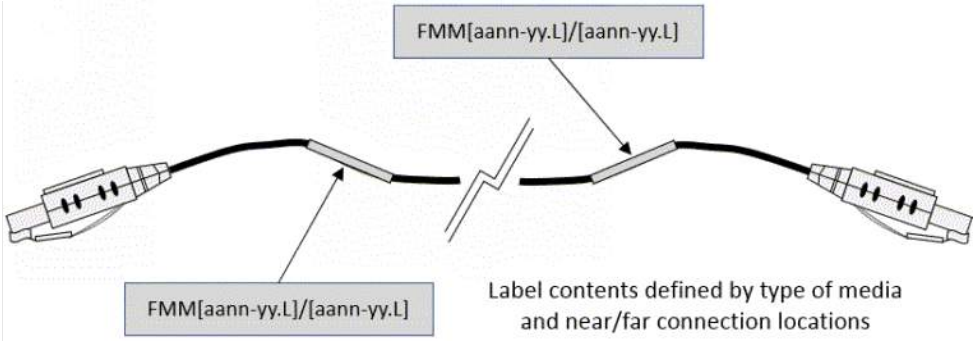

Figure 30: Detailed Example of Communications Cable Labeling

5.2.6 IT Equipment Rack/Cabinet Labeling

To cross-identify network and IT equipment enclosures (hereafter, generically referred to as 'racks') located on the floor with critical safety information (including power sources), each rack shall be labeled with its physical location (grid identification) and power distribution sources. Rack identifying physical location shall be posted on both the front and rear of each rack, on the frame above or at the top of the door (as applicable).

5.2.7 Power Whip IT Equipment In-Rack/In-Cabinet Power Distribution Labeling

Rack power information shall be labeled on each individual vertical rPDU, on the frame behind the door, front and back, as well as on the doors, front and back. Machine-printed paper tags secured with clear plastic or acetate adhesive tape are the minimum standard for these tags. Hand written labels of any type are not permitted.

Alternative IT equipment (non-rack based) shall be labeled with physical location (grid identification) and power distribution sources and with any additional identifying information needed to identify that specific piece of equipment. Install power designator labels near or on the power cord leaving the equipment. Place equipment location tags on the front top, or at location associated with the first full tile closest to the origin.

5.2.8 Power Distribution to IT Labeling

Data center power distribution components such as breakers, switches, receptacle junction boxes, and IT equipment power circuits ("whips") shall be labeled with approved machine generated adhesive tape, cable tags or other approved method. Hand written labels of any type are not permitted.

All non-IT power distribution in the data center space should be labeled in the same manner to ensure a safe environment. All electrical equipment which is served by, or which contains multiple sources of power, shall comply with NFPA 70 standards to identify both disconnecting means.

The source end of each whip shall be labeled within 3 ft of the conduit leaving the distribution panel enclosure. The point-of-use end of each whip shall be labeled on the junction box, on the connector, or within 1 ft of the end of the conduit.

Labels installed internal to electrical or electronic components shall not provide a ground or short circuit path or interfere with the operation of components.

5.2.9 Physical Label Format

Labels on power whips shall contain the following information:

- PDU/Panel Source
- Circuit Number
- Whip Length
- Equipment Location
- Receptacle Type

Figure 31 below shows an example of a self-adhesive label for use on a whip. There is no prescribed format for these labels.

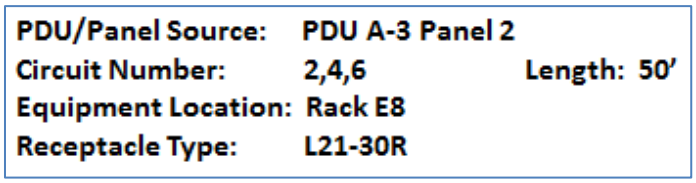

Figure 31: Power Whip Label Example

5.3 Management Standards

5.3.1 Color Coded Identification

Table 49: Color Identification Conventions

ID	Primary Attribute	Secondary Attribute	Specification
1	Color Identification	Backbone Telecommunications Cabling	See Table 32
		Telecommunications Patch Cabling	Not specified, follow local site schema
		Power Distribution	Colors shall be black on A-side and other distinguishable color on B-side to differentiate electrical bus power sources

5.3.1.1 Data Communication Cabling Color Coding

The ISTS does not specify an enterprise color scheme for UTP patch cords. Color coding scheme for patch cords should be avoided, however; individual site schemas are acceptable if consistent and documented.

5.3.1.2 Power Distribution Color Coding

All redundant power distribution within the computing spaces shall incorporate specific color identification to differentiate between different electrical bus power types. Use of specific color identification for each electrical bus shall stay consistent throughout building distribution. No enterprise color specification is prescribed. A suggested strategy is to use blue Liquid-tight Flexible Metal Conduit (LFMC) conduit for A-bus circuits and grey LFMC conduit for B-bus circuits. Use of different label colors to differentiate electrical bus power is an acceptable solution.

Within IT equipment racks/cabinets, separate A-side and B-side power and segregate equipment power cords (between vertical rack power distribution units and IT equipment) by color (black on A-side and other distinguishable color on B-side) for identification of A/B power to each piece of IT equipment (see example below). Follow best practices for managing the power cords similarly to other cabling.

Figure 32. Example of Best-Practice Differentiated Power Cord Coloration Implementation

5.3.2 Management of Telecommunications Cabling

Cable management is largely qualitative in nature, requiring the exercise of judgment by IT staff. Proper cable management is necessary to enable optimal airflow through IT equipment (minimizing energy usage), to allow identification and management of cabling throughout the IT equipment lifecycle, and to minimize risks of damage to the networking system by minimizing opportunities for damage to cables, connectors, and conveyances. Aesthetically, proper cable management reflects the professional approach expected and necessary to support the mission of providing the best possible IT support to the Veteran.

Evaluation Factors

- Cable management allows appropriate airflow
- Cables properly labeled to allow easy identification
- Cable management is organized, logical, systematic, and aesthetic

Implementation Guidance

Cabling plants shall be planned to enable the installation of IT equipment. Install and utilize cable conveyances (cable trays, cable managers, and similar) in all IT installations. Free-run telecommunications cabling is not maintainable or sustainable and has a higher lifecycle cost than properly designed and installed cabling plant systems.

- Cabling shall be run in horizontal, vertical, or overhead cable management systems where available. Procure and install cable management equipment when cabling installations need such to enable aesthetic, managed cabling outcomes.
- Always plan the cabling path and manage the cabling installation, down to the level of the patch cord to the individual piece of IT equipment. Individual cables shall not be free-run.

- Individual cable lengths shall be selected appropriately for their purpose. Cable slack shall be managed with attention to installation criteria such as bend radius. Excessive slack indicates a poor choice of cable length.
- Patch cords shall not be run from one IT equipment rack to another.
- Power cords shall not be run from one IT equipment rack to another. Power distribution specifically calls out zPDUs that supply power to multiple racks to obtain maximum power densities. These devices and their power supplies are not affected by this guidance.
- Power cords shall be matched to the manufacturer specifications for the hardware receptacles intended without the use of adapters.
- Patch and power cords shall not be left unmanaged where they may interfere with exhaust airflow or have the potential to catch or snag on people or equipment.
- Document all cabling components and their linkage between components and make sure that this information is updated on a regular basis. The installation, labeling, and documentation should always match. Maintain cabling documentation, labeling, and logical/physical cabling diagrams.
- No enterprise color scheme is specified for UTP patch cords. Where a local or organizational color scheme for cabling exists, it shall be followed. Color schemes for patch cords should be avoided.
- Consider vendor-specific IT equipment requirements for cabling so as not to impede intended operation of that equipment, such as blocking exhaust ports. For example, cabling management in the picture below is appropriate except for the aqua-colored cables entering from the left, which cover the fan module on the left of the switch. This keeps the fan module from being replaced without disconnecting the network.

Figure 33: Equipment-Specific Cable Management Requirements

Below (Figure 34) are examples of aesthetically *acceptable* cabling management implementations. No installation is ever optimal for all considerations, but these represent the level of workmanship expected in the VA computer room environment.

Figure 34: Acceptable Cable Management Results

Below (Figure 35) are examples of *unacceptable* cabling management implementations that will require remediation.

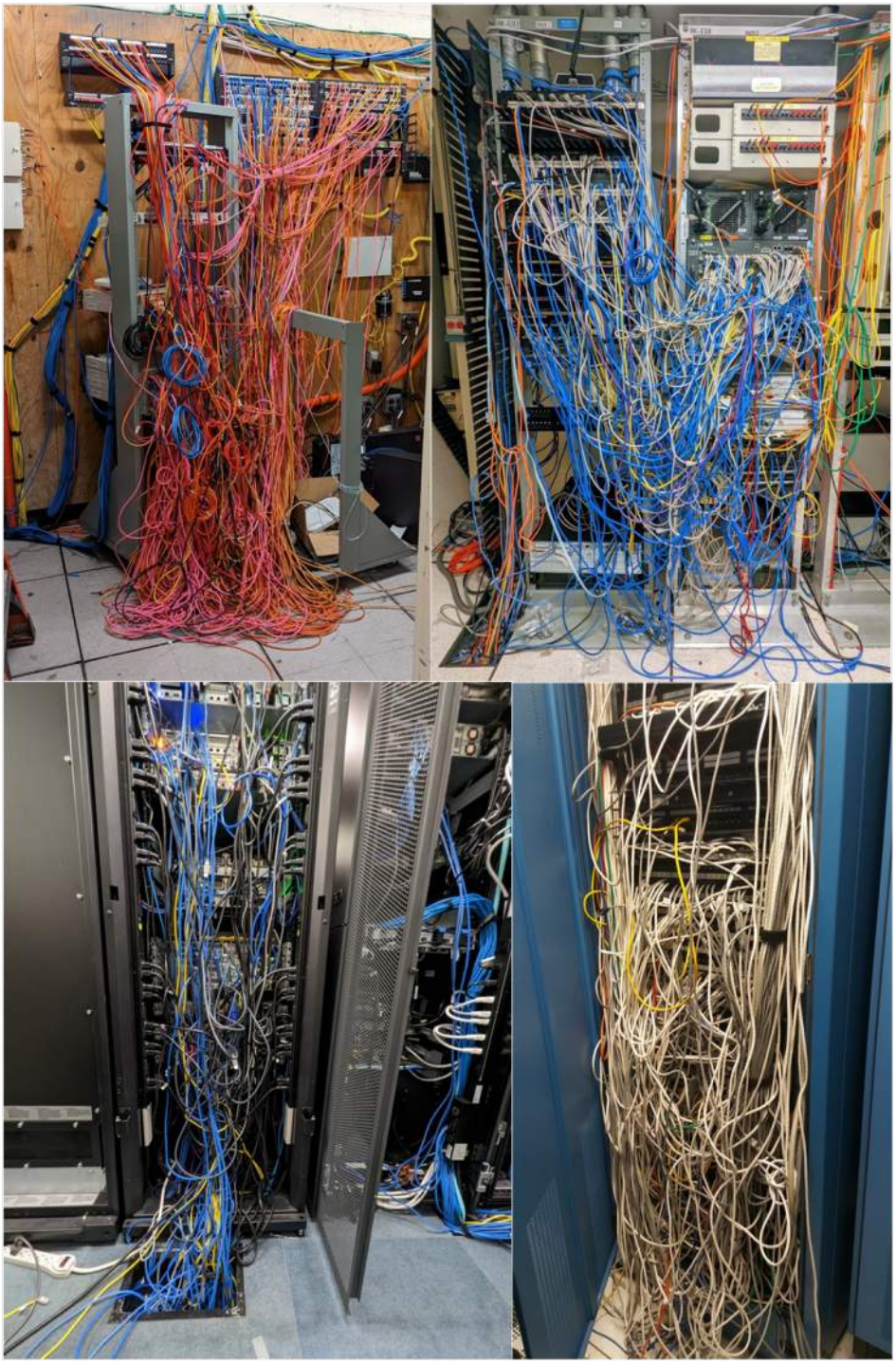

Figure 35. Unacceptable Cable Management Results

5.3.2.1 Installation Guidance

- Cross-connects are only authorized at the MDAs, HDAs, TRs, and entrance rooms.
- No splicing or intermediate cross-connecting are authorized for intra-building or inter-building connectivity.
- All TRs shall be connected directly to the MDAs.
- All cabling shall be installed in a neat, workmanlike manner without twists, kinks, and unnecessary crossovers.
- Cables should not be in contact with the ground. Use cable management components and techniques to maintain a clean, clear, and safe work environment.
- Do not mount cabling in locations that block access to other equipment (e.g., power strip or fans) inside and outside the racks.
- Patch cords should follow the side of the IT equipment rack closest to the assigned network interface card.
- Cables should not be looped around themselves or other objects.
- Route cables with gentle loops to avoid damage due to exceeding bend radius limitations. Glass fiber can be easily broken with rough handling or overly tight bends.
- Cables should be tight enough to maintain position but not tight enough to deform the jacket or put tension on the connectors.
- Based on heat exhaust (airflow), serviceability, and excess cable lengths, do not install folding/retractable cable management arms for IT equipment in VA computer spaces. Arms currently installed on existing equipment may be used until the equipment is refreshed and removed.
- All cable slack should be concealed within the rack either vertically or within cable managers. Slack should not be looped. With use of the correct length cables, there should not be sufficient slack to enable looping.
- Use the correct length patch cords.
- Cables should not be twisted or wrapped around other cables, including when bundled.

5.3.2.2 Cable Bundling Guidance

- Bundle cables together in groups of relevance (for example, cables to a single equipment distributor or uplinks to core devices), as this will ease management and troubleshooting.
- Bundles of cables, when necessary, should be built from sub-bundles of no more than 6-8 individual cables. The larger bundles should not exceed four sub-bundles of like quantity.
- When bundling or securing cables, use Velcro-based ties not more than every 3 ft (1 m) to 6 ft (2 m), and more frequently as needed to maintain a clean installation. Do not use zip ties or twist ties for cable bundling or securing, as these apply pressure on the cables.
- Only bundle like cable types. Do not bundle fiber, power, and UTP together.
- Cable labels shall be visually accessible to local personnel following installation, for future identification and troubleshooting purposes. Rather than bundling groups of cabling in a manner that prevents identification of individual cables, bundle in a different manner and/or relocate the cabling to locations where they will not be obscured. Consider bundling so all cables are on the exterior of the bundle, so they are visible as shown in Figure 36 below. The exception to this is when factory pre-bundled cabling is used.

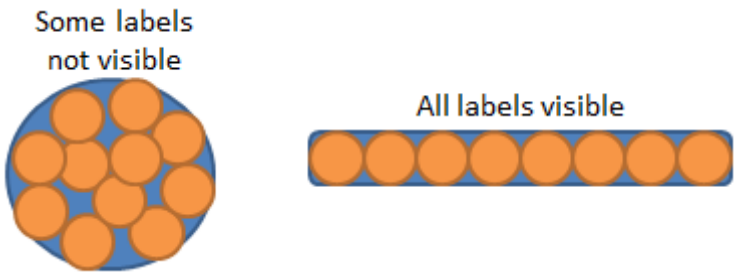

Figure 36: Cable Labels in Bundles

5.3.2.3 Unshielded Twisted Pair, Fiber, and Power Cabling Guidance

- Segregate power and telecommunications cabling in separate cable tray systems; use different conveyance systems located not less than 1 ft apart when these two systems are run in parallel.
- Where possible, run power and telecommunications in separate paths to reduce risks of Electromagnetic Interference (EMI)/Radio Frequency Interference (RFI) and data transmission losses.
- Do not install UTP cabling on top of fiber cabling to prevent damage to the fiber transmission medium.
- Segregate UTP and fiber telecommunications cabling, using different conveyances where possible. Where not possible or provided, ensure fiber cable is protected from damage. Use fiber innerduct where necessary within the same cabling conveyance.
- Use properly-sized equipment power cords; use of 6 ft length power cords where 2 ft cords are needed is not considered a best practice.
- Separate A-side and B-side power and segregate equipment power cords (between vertical rack power distribution units and IT equipment) by color for identification of A/B power to each piece of IT equipment. Follow best practices for managing the power cords similarly to other cabling.

5.3.3 Management of Airflow

VA computing facilities shall utilize engineered, verified layout designs to optimize energy usage in the environmental control systems supporting the facilities. Proposed deviation from standard layout design requires verification and validation by DCIE and CFD analysis.

Evaluation Factors

- Designated hot and cold aisles are utilized in facilities with more than eight IT equipment rack/cabinet equivalents.
- Perforated floor tiles and similar vents are strategically placed to prevent cooling air supply is not directly mixed with return air
- Blanking panels and air dams are deployed in all IT equipment cabinets to minimize bypass air across the surface area of the cabinets.

Implementation Guidance

Unless otherwise designated through validated engineering design, utilize a hot/cold aisle arrangement for equipment located in VA data centers. This applies to both facilities that use a raised access floor plenum for cooling distribution and those that do not.

5.3.4 Physical Access to Telecommunications Spaces

VA telecommunications spaces are intended to support all distributed equipment telecommunications requirements of all users of the facility in a combined manner. Separate telecommunications spaces to support individual functions are unnecessary and wasteful of limited resources. Multiple data centers (computer rooms) on a campus or supporting a single facility are prohibited.

Distributed equipment systems of all facility stakeholders (e.g., nurse call, telemetry, distributed antenna systems, security systems, other 'special telecommunications systems,') and backbone/horizontal distribution for all these types of systems are deployed to the same TR.

Administrative solutions to physical access to VA telecommunications spaces for all user groups with valid technical reasons to routinely access the spaces (e.g., OIT, FMS, CE, R&D, police, custodial staff, etc.) are required to support mission requirements.

5.3.5 Custodial Services

Custodial services are required to be provided for telecommunications spaces:

- Clean floors to prevent an excessive buildup of dust, dirt, or floor finish on floor surface, along walls, and in corners. Ensure electrostatic discharge coating for raised floor systems and static dissipative coating or material for slab floors and other qualities of the surface are maintained as designed.
- Remove accumulation of dust, dirt, grime marks, streaks, smudges, or fingerprints from all vertical and horizontal surfaces.
- Empty all trash containers.
- Dust lights and fixtures.
- Replacement of burned-out lamps.

Appendix A: Request for Variance

A.1 Request for Variance from Infrastructure Standards

An updated printable Request for Variance form has moved to permanent storage on the Technical Information Library (TIL).

Requests for variance for allowable deviations from specific requirements of any standards published within may be authorized where a proposed alternate method of installation or operation will provide equal or higher safety, reliability, redundancy, or sustainability objectives. Requests for variance shall be submitted for consideration to DCIE (VAITESEDatacenterEngineering2@va.gov) using a Request for Variance form. If a variance is granted, it shall be limited to the particular site and installation covered in the application and will NOT be considered as a precedent for other installations.

Note: This is a separate process from VHA's process and form for requesting variances from other TIL standards and design manuals.

A.2 Request for Change to Infrastructure Standards for Telecommunications Spaces

Requests for changes shall also be submitted to DCIE (VAITESEDatacenterEngineering2@va.gov) for consideration using a Request for Variance form. If approved, the proposed change(s) will be ratified through the Enterprise Baseline and Standard Review (EBSR) process and submitted to the Enterprise Change Advisory Board (CAB) for final approval (if required) before publication.

Appendix B: OIT Design Guide Templates

B.1 Design Narrative

The Data Center and Infrastructure Engineering (DCIE) team has developed the OIT Design Guide Templates for Critical Infrastructure in Telecommunications Spaces, also located at this link in the Technical Information Library, for Architect/Engineer (A/E) partners to use in their data center design drawing development for new construction, restoration, and modernization projects across VA. These generic Main Computer Room (MCR), entrance room, and Telecommunications Rooms (TR) designs can be applied without significant modifications to future construction projects.

The existence of a standardized, standards-based design will prevent non-compliant, incorrectly sized, unbalanced, and unsustainable data center designs from being produced by VA mission partners, will reduce design project timelines and costs, and prevent unnecessary rework and change orders.

These designs utilize a standardized ANSI/TIA-942-B Telecommunications-Electrical-Architectural-Mechanical (TEAM) approach that will allow A/E designs to separate requirements by discipline. Disciplines not directly related to the telecommunications infrastructure (e.g., structural, plumbing, fire protection) are not addressed. The use of these templated layouts and outfitting plans is required for VA telecommunications space design, construction, and modernization efforts. They provide a ninety percent solution for most designs; however, projects in the planning, design, or implementation phases shall contact DCIE for additional assistance in telecommunications space design and standards compliance.

Iterative CFD analysis shall be used to determine heat rejection equipment sizing, layout, and operating parameters to minimize energy usage by the mechanical systems when templates cannot be used without modification for CDC, CSC, and MSC data center classifications.

Transmit all communications to DCIE at VAITESEDatacenterEngineering2@va.gov.

B.2 Main Computer Rooms

Main Computer Rooms (MCR) serve as Campus Support Centers (CSC) and provide IT services for most typical VA Medical Center (VAMC) campuses.

These spaces are intended to provide for collocation of IT equipment and systems from all provider organizations including VAMCs, VBA Regional Offices, Office of Information Field Office (OIFO), R&D, Police, Security, local FMS, Health Informatics, CE, etc. into the minimum number of operational spaces on a campus; that is, consolidated data centers providing environmental and area network support appropriate to all IT equipment needed by tenant organizations on a particular campus to perform their missions. Legacy MCRs typically support between 25 kW and 75 kW of critical load, with significant additional loads anticipated as VA modernizes electronic health record systems and deploys additional medical systems increasingly dependent upon IT systems.

Analysis of IT trends and projected needs has led VA to standardize on a single CSC design appropriate for an estimated 90 % of VAMCs' needs for a twenty-year data center life cycle. Most medical centers will require a 'small' design to support their IT requirements (see Sheet 09, Small Data Center). Only a few will require larger design sizes or capabilities. Unless otherwise indicated by DCIE, utilize a 'small' design for computer rooms to support VAMCs. Consult DCIE for design details for this type of facility.

For Ambulatory Care Centers (ACCs), Health Care Centers (HCCs), Community Based Outpatient Centers (CBOCs), and other classifications of VA healthcare facilities that may provide limited clinical services, an 'extra-small' design or smaller footprint will typically be appropriate. Guidance for these generally smaller healthcare facilities may be found in VA's Lease Design Narrative (LDN). Consult DCIE for design details for non-leased facility design efforts.

For Core Data Centers (CDC) and Mission Support Centers (MSC), consult DCIE for the appropriate size and design during project scoping for these classifications.

B.3 Entrance Rooms

Entrance rooms are a subset of the NSC classification archetype with less stringent temperature range requirements. Entrance rooms have the additional requirement of matching the electrical distribution and heat rejection redundancy requirements of the computer room that they support.

In new construction, the entrance rooms require special consideration for earlier beneficial occupancy than other building functions. Plan completion of construction and outfitting of entrance rooms to occur earlier in projects than for other telecommunications spaces. Entrance room outfitting must be complete by the time that carrier circuits and carrier equipment from service providers are brought onto campus, allowing other systems to be tested and commissioned.

Carrier circuits shall be terminated in entrance rooms generally located in the same building as the MCR.

There shall be a minimum of one entrance room per campus. Individual buildings do not require separate entrance rooms, as VA does not use building distributors in its design for the converged physical telecommunications infrastructure. Entrance rooms shall be a minimum of 80 ft² for a one-rack entrance room and an additional 20 ft² for each additional rack required (see sheet four).

Two entrance rooms are required for the diverse providers for CDCs and CSCs with a minimum separation of 66 ft (20 m) between entrance points and entrance rooms. Entrance points located 180° apart (on opposite sides of a building) are preferred, both to service entrance rooms and in buildings supported by the campus backbone.

Health care facility entrance rooms shall be a minimum of 170 ft². See Sheet 04, Telecommunications Entrance Rooms, for construction and outfitting guidance for these redundant entrance rooms.

Follow guidance for the NSC telecommunications space classification (and entrance room specific exceptions) in the Standard for electrical distribution and environmental control requirements for these spaces.

B.4 Antenna Entrance Rooms

Antenna entrance rooms are a subset of the NSC classification archetype with less stringent temperature range requirements. Antenna entrance rooms are the telecommunications entrance room for roof-mounted antenna, microwave, satellite dish, and other telecommunications services mounted at the roof level. They accommodate all provided and planned Radio Frequency (RF) based systems and headend equipment cabinets housing cellular reinforcement Distributed Antenna System (DAS), Master Antenna Television (MATV), Television Receive Only Master Antenna Satellite Television (TVRO), Very Small Aperture Terminal (VSAT), High Frequency (HF), microwave, Radio Entertainment Distribution (RED), Public Address (PA), Two-Way Radio, Radio Paging System (RPS), and Video Surveillance Systems including Closed Circuit Television (CCTV), Security Surveillance Television (SSTV), etc.

This room will have the same TIA-942 rating as lower entrance rooms, but will have additional power, racks, and bonding to support the associated carrier and radio equipment. Where feasible, all signal amplifiers, carrier equipment, cellular transceivers, etc. for intrabuilding DAS and public access cellular service should be installed in this entrance room. Generally, a single antenna entrance room shall be present for a medical center and other large healthcare facilities.

See Sheet 07, Antenna Entrance Room, for construction and outfitting guidance for these entrance rooms.

B.5 Telecommunications Rooms

Backbone media from the MCR terminates in Telecommunications Rooms (TR) distributed around the buildings on campus, which provide horizontal distribution media to end-user WAOs.

There shall be a minimum of one TR per floor. Telecommunications rooms shall be a minimum of 80 ft² for a one-rack TR and an additional 20 ft² for each additional rack required (see Sheet 5 of Appendix B).

Health care facility TRs shall be a minimum of 170 ft².

Telecommunications Room construction and outfitting requirements are detailed in sheet five of Appendix B. Follow guidance for the NSC telecommunications space classification in the Standard for electrical distribution and environmental control requirements for these spaces.

Multiple organizations including Veterans Affairs Medical Centers (VAMC), VBA Regional Offices, Office of Information Field Office (OIFO), Research & Development (R&D), Police, Security, local Facilities Management Service (FMS), Health Informatics, CE, etc. use TRs for their distribution, security camera feeds, cable TV, etc. The TRs are intended to provide for collocation of IT equipment and systems from all provider organizations into the minimum number of operational spaces on a campus; that is, consolidated TRs providing environmental

and area network support appropriate to all IT equipment needed by tenant organizations in the TRs to perform their missions.

VA TRs are intended to support all distributed equipment telecommunications requirements of all users of the facility in a combined manner. Separate TRs to support individual functions (e.g., OIT, FMS, CE) are unnecessary and wasteful of limited resources.

Distributed equipment systems of all facility stakeholders (e.g., CE, nurse call, telemetry, distributed antenna systems, security systems, other 'special telecommunications systems,' and backbone/horizontal distribution for all of these types of systems) are deployed to the same TR. End-user devices for these systems shall be connected via horizontal distribution from the TR serving the zone in which the device(s) are located.

Administrative solutions to physical access to VA telecommunications spaces for all user groups with valid technical reasons to routinely access the spaces (e.g., OIT, FMS, CE, R&D, police, custodial staff, etc.) are required to support mission requirements.

B.6 Telecommunications Enclosures

Standardized Telecommunications Enclosures (TEs) are authorized for use in lieu of a TR in specific limited circumstances where a standard TR is not feasible or warranted for the telecommunications space.

See Sheets 12-17, Telecommunications Enclosures, for construction and outfitting guidance for TEs.

Implementation Guidance

Space classification. Telecommunications Enclosure (TEs) may be deployed to the following types of non-healthcare spaces (any space below may also be granted a variance to use a TR less than 80 ft² as long as the excepted clearance requirements are maintained and the maximum of 96 WAOs is not exceeded):

- Parking structures
- Technical spaces such as warehouses, kitchens, laundries, mechanical/electrical plant buildings, chiller or boiler plants, garages, and paint shops
- Historical quarters converted to administrative use
- Buildings with no or limited VA staffing presence and limited connectivity requirements such as gyms, auditoriums, chapels, etc.
- Temporary modular trailers (Temporary buildings and trailers must be validated to be actually temporary, with a planned date of removal and no history of previously deferred or canceled removal plans)
- NCA field facilities
- Fisher House buildings
- VHA mental health administration facilities (veterans centers)

A maximum of 96 WAOs can be supported by a standardized TE. Each data jack in a workspace telecommunications outlet, wired back to the patch panels in the TE, is considered a WAO for

these purposes. Where 1-48 WAOs are planned, a 12RU (half-height) standardized TE is used. Where 49-96 WAOs are planned, a 26RU (full-height) standardized TE is used.

No services other than VA LAN horizontal distribution can be supported from a standardized TE, except in a building with no VA staffing presence and no requirements for VA LAN but where guest WiFi is provided.

TEs may be deployed to spaces falling within the environmental envelope conditions for a TR, as described in the ISTS. Ambient air conditions in the space are between 41 °F - 95 °F dry bulb, 8 % - 80 % RH, and a dew point less than 82.4 °F.

Non-standard environmentally conditioned TEs may be approved by variance for use in spaces where the ambient air conditions extend outside of these limits.

All knockouts and cable entry points shall be sealed to prevent liquid and dust entry.

Accessories include cable port brush kit, low-noise dual fan and filter kit, replacement filter kit, shelves, vertical rail-mounted cable managers, and LED light kit.

Criteria requirements for diverse path backbone:

- Supports VA clinical staff function in a healthcare setting
- Supports VA clinical-supporting staff function with end-user desktop and/or VOIP phone requirement
- Supports VA administrative staff function with end-user desktop and/or VOIP phone requirement (reduced fiber count routing may be considered if space cannot be used for a healthcare/clinical function, e.g., Washington DC administrative buildings, VBA regional office buildings)
- Not required for patient-only areas without any VA staffing function presence (non-diverse and reduced fiber count routing may be considered)
- Not required for VA technician, maintenance, or trades areas or facilities (non-diverse and reduced fiber count routing may be considered)

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C.3 Definitions

Access Provider: The operator of any facility that is used to convey telecommunications signals to and from a customer premises.

Administration: The method for labeling, identification, documentation, and usage needed for installation, moves, additions and changes of the telecommunications infrastructure.

Alarming: Communicating when an absolute limit has been exceeded.

Alerting: Communicating when a condition threshold has been reached or exceeded.

American Society of Heating and Air-Conditioning Engineers (ASHRAE) Recommended Monitoring Locations (Modified):

- Front Top (FT): Centered horizontally, inside the front door, no more than 1 ft from the top of the cabinet
- Front Middle (FM): Centered horizontally, inside the front door, 4 ft +/- 6 in. from the finished floor surface
- Front Bottom (FB): Centered horizontally, inside the front door, no more than 1 ft from the finished floor surface
- Rear Top (RT): Centered horizontally, inside the rear door, no more than 1 ft from the top of the cabinet
- Rear Middle (RM): Centered horizontally, inside the rear door, 4 ft +/- 6 in. from the finished floor surface (not required by VA but recommended)
- Rear Bottom (RB): Centered horizontally, inside the rear door, no more than 1 ft from the finished floor surface (not required by VA but recommended)

Antenna Entrance Room: A room to accommodate all provided and planned Radio Frequency (RF) based systems and headend cabinets and equipment.

Backbone:

- A facility (e.g., pathway, cable, conductors, optical fibers) between any of the following spaces: telecommunications rooms (TRs), Telecommunications Enclosures (TE), common TRs, floor-serving terminals, entrance facilities, equipment rooms, and common equipment rooms.
- In a data center, a facility (e.g., pathway, cable, conductors, optical fibers) between any of the following spaces: entrance rooms or spaces, antenna entrance rooms, Main Distribution Areas (MDA), Horizontal Distribution Areas (HDA), Zone Distribution Areas (ZDA), and TRs.

Backbone Bonding Conductor: A telecommunication bonding connection which interconnects telecommunications bonding.

Busway: A pre-fabricated electrical distribution system used as an effective alternative to cable and conduit consisting of busbars in a protective enclosure, including straight lengths, fittings,

devices, and accessories. Busway transports electricity and connects to electrical gear such as switchgear, panelboards and transformers.

Bonding: The permanent joining of metallic parts to form an electrically conducive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed.

Cabinet: A container that may enclose connection devices, terminations, apparatus, wiring, and equipment.

Channel: All telecommunications cable elements, permanent cable (link) and patching elements, that connect two pieces of IT equipment.

Channel Rack: A network four-post rack with sides having a cable management pattern of staggered shapes (circles, hexagons, etc.) to allow for connection points for cable management accessories used for housing networking equipment.

Compression Connection: A means of permanently bonding a conductor to a connector by permanently deforming the connector using a compression tool.

Computer Room: An architectural space whose primary function is to accommodate data processing equipment.

Concurrently Maintainable: The ability to have planned maintenance performed at any time on any path, equipment, or component of the system without interrupting the operation of the system.

Cross-connect: A facility enabling the termination of cable elements and their interconnection or cross connection.

Conduit: (1) A raceway of circular cross-section. (2) A structure containing one or more ducts.

Data Center: A building or portion of a building whose primary function is to house a computer room and its support areas.

Demarcation Point: A physical location, typically in the entrance room, where the operational control or ownership of the incoming service provider media changes from Service Provider to customer.

Dew Point: The temperature to which air must be cooled (assuming constant air pressure and moisture content) to reach a relative humidity of 100 % (i.e., saturation).

Electromagnetic Interference (EMI): Radiated or conducted electromagnetic energy (noise) of any frequency that has an undesirable effect on electronic equipment or signal transmissions.

Entrance Room: A space in which the joining of inter or intra building telecommunications cabling takes place.

Equipment Distributor (ED): Reservation of the top 5 Rack Units (RU) of space in a server cabinet for copper and fiber patch panel equipment.

Exothermic Weld: A method of permanently bonding two metals together by a controlled heat reaction resulting in a molecular bond.

Facility Total Electrical Consumption (FEC): Total of all energy used from all sourced by the building housing the data center. This metric requires totaling the amount of electrical energy going into the building through the building's main step-down transformer(s) and the amount of electrical energy generated through running any facility or data center generator equipment.

Ground: A conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

Grounding: The act of creating a ground.

Grounding Electrode: A conductor, usually a rod, pipe, or plate (or group of conductors) in direct contact with the earth for the purpose of providing a low-impedance connection to the earth.

Grounding Electrode System: One or more grounding electrodes that are connected.

Horizontal Cabling: (1) The cabling (media) between and including the telecommunications outlet and connector and the horizontal cross connect, usually in a telecommunications room. (2) Within a data center, the media between the equipment distributor and the horizontal distributor.

Horizontal Distribution Area (HDA): Distribution used to serve equipment areas when the horizontal cabling is not located in the main distribution area. When used, the horizontal distribution area may include the horizontal cabling, which is the distribution point for cabling to the equipment distribution areas.

Information Transport Systems (ITS): The physical connectivity elements required to deliver a high-performance, reliable network system infrastructure for all requirements including data, voice, and video.

Infrastructure (telecommunications): A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of information within a building or campus.

Link: A single permanently-installed telecommunications cable element. See also permanent link.

Listed: Equipment included in a list published by an organization, acceptable to the authority having jurisdiction, that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Main Distribution Area (MDA): The central point of distribution for the data center structured cabling system which includes the main cross-connect and may include horizontal cross-connect when equipment areas are served directly from the main distribution area.

Mechanical Connection: A reversible means of connecting a conductor to a connector using a set screw or other bolt and nut device.

Mechanical Room: An enclosed space serving the needs of mechanical building systems.

Media: Wire, cable, or conductors used for telecommunications (transmission of signal).

Mesh Bonding Network: The set of metallic components that are interconnected to form the principle means for effectively bonding equipment inside a building to the grounding electrode system.

Metering: Measurement of a condition or set of conditions over a period of time. Metering is primarily a data collection function, intended to support analysis of operational characteristics of a data center.

Monitoring: Continual real-time observation of a condition or set of conditions affecting a data center.

Multimode Optical Fiber: An optical fiber that carries many paths of light.

Patch Cord: A cord used to establish connections on a patch panel.

Patch Panel: A connecting hardware system that facilitates cable termination and cabling administration using patch cords.

Pathway: A facility for the placement of telecommunications cable.

Permanent Link: The permanent, or fixed part of the network comprised of components that will permanently stay in place, such as patch panels, horizontal or backbone cable, and an outlet.

Plenum: A compartment or chamber to which one or more air ducts are connected and forms part of the air distribution system.

Pod: A modular subset of the data center.

Power Usage Effectiveness (PUE): A dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. PUE is defined as the ratio: Total Data Center Energy Consumption (TEC)/Total IT Equipment Energy Consumption (TITEC) or TEC/TITEC.

Primary Bonding Busbar (PBB): The dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The PBB also serves as the central attachment point for the TBB(s) and equipment.

Rack: Supporting frame equipped with side mounting rails to which equipment and hardware are mounted.

Rack Bonding Busbar (RBB): A busbar within a cabinet, frame, or rack.

Rack Bonding Conductor (RBC): The bonding conductor from the rack or rack bonding busbar to the telecommunications equipment bonding conductor.

Rack Unit (RU): Vertical mounting space of 1.75 in. for cabinets or racks compliant with IEC 60297 or EIA/ECA-310-E.

Radio Frequency Interference (RFI): Radiated or conducted electromagnetic energy (noise) of a specific frequency that has an undesirable effect on electronic equipment or signal transmissions.

Raised Floor aka Access Floor: A platform with removable panels where equipment is installed, with the intervening space between it and the main building floor used to house the interconnecting cables and at times is used as a means for supplying conditioned air to the IT equipment and the room.

Secondary Bonding Busbar (SBB): A common point of connection for telecommunications system and equipment bonding to ground located in the distributor room.

Service Provider: The operator of any service that furnishes telecommunications content(transmissions) delivered over access provider facilities.

Single-Mode Optical Fiber: An optical fiber that carries only one path of light.

Site Infrastructure Energy Efficiency Rating (SIEER): A dimensionless metric which describes how efficiently a data center is designed and operated to conserve power. SIEER is defined as the ratio: Total Data Center Energy Consumption (TEC)/Total Uninterruptible Power Supply (UPS) Load Energy Consumption (TUPEC) or TEC/TUPSC.

Telecommunications: Any transmission, emission, and receptions of information by cable, radio, optical, or other electromagnetic systems including signaling commonly referred to as "data."

Telecommunications Room (TR): A telecommunications space that differs from equipment rooms, entrance rooms, and antenna entrance rooms in that this space is a floor-serving space that provides a connection point between backbone and horizontal cabling. The terms "closet," "telecom closet," "phone closet," "Intermediate Distribution Frame (IDF)," etc. are no longer used. Design documents are to use the abbreviation "TR."

Telecommunications Space: An area used for housing the installation and termination of telecommunications equipment and cable. Telecommunications spaces include telecommunications rooms, entrance rooms, antenna entrance rooms, data centers, computer rooms, horizontal pathways, vertical pathways, etc. The term "telecommunications spaces" is used interoperably with the term "IT support space."

Total Data Center Energy Consumption (TEC): Summation of all energy used from all sources required to power all infrastructure and equipment within the confines of a data center.

Total Data Center Physical Infrastructure Energy Consumption: Summation of all energy used by facilities physical infrastructure equipment that supports the computer space. This is the total amount of electricity necessary to run all mechanical and electrical equipment providing support to the computer space but does not include the IT Equipment Load Electrical Consumption.

Total IT Equipment Energy Consumption (TITEC): Summation of all energy directly consumed by IT equipment in the data center. IT equipment includes, but is not limited to, computers, storage systems, and networking gear.

Total Renewable Energy Usage by Data Center (RENEW): Summation of all electricity consumed by the facility housing the VA computer facility generated from renewable resources (solar, wind, hydro, wave, and similar) locally or through the supplying utility. Hydrocarbon and nuclear utility sources are not considered renewable for the purposes of this value.

Total UPS Load Energy Consumption (TUPEC): Summation of all energy used on the load (not source) side(s) of all UPS system(s) supporting the critical load in the computer space.

Track Busway: A continuous rail design where tap-off boxes can be installed or removed nearly anywhere along the busway system. The tap-off boxes come equipped with cord whips and fixed receptacles allowing for power distribution to equipment below the busway.

Uninterruptible Power Supply (UPS): A buffer between utility power or other power source and a load that requires continuous precise power.

Work Area: A building space where the occupants interact with telecommunications terminal equipment.

Work Area Outlet (WAO): A fixed connector in an equipment outlet assembly consisting of faceplate, body, housing, and one or more telecommunications cabling interface in the building

space where the occupants interact with telecommunications terminal equipment. The term "jack" is no longer used.

Zone Distribution Area (ZDA): A space in a data center where an equipment outlet or a consolidation point is located.

C.4 References

References are effective from their date of publication unless otherwise stated and are inclusive of supplements or addenda published by the standards body, amendments adopted by Authority Having Jurisdiction (AHJ), and superseding standards. The list is not comprehensive; compliance with all applicable standards is required. References consist primarily of nationally recognized "model" building codes, and technical standards developed or adopted by voluntary consensus standards bodies, use of which is required by P.L. 100-678, P.L. 104-113, and OMB Circular A119.

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ANSI/TIA/EIA-492CAAB, Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak

ANSI/TIA-568-Set, Commercial Building Telecommunications Cabling Standard

ANSI/TIA TSB-153, Static Discharge Between LAN and Data Terminal Equipment

ANSI/TIA TSB-155-A, Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

ANSI/TIA TSB-184-A, Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

ANSI/TIA TSB-184-A-1 (Addendum to TSB-184-A), Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling-Addendum 1- use of 28 AWG cords

American Society of Heating and Air-Conditioning Engineers (ASHRAE) Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices Removal by Particle Size (ANSI approved)

ASTM B258, Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors

ASTM B539, Standard Test Methods for Measuring Resistance of Electrical Connections (Static Contacts)

ASTM D4565, Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

ASTM D4566, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

ATIS 0600311, DC Power Systems Telecommunications Environment Protection

ATIS 0600336, Design Requirements for Universal Cabinets and Framework

BICSI ITSIMM, Information Technology Systems Installation Methods Manual (ITSIMM) - 8th Edition

BICSI OSPDRM, Outside Plant Design Reference Manual (OSPDRM) - 6th Edition

BICSI TDMM, Telecommunications Distribution Methods Manual - 14th Edition; Volumes I & II

CSI MASTERFORMAT ™ 2020 EDITION NUMBERS & TITLES Construction Specifications Institute (CSI)

ECIA EIA/ECA-310-E, Cabinets, Racks, Panels, and Associated Equipment

Executive Order No. 13693 "Federal Leadership on Climate Change and Environmental Sustainability" 2015

Executive Order No. 13834 "Efficient Federal Operations" 2018

Federal Information Processing Standard (FIPS) 200, Minimum Security Requirements for Federal Information and Information Systems

IEEE STD 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System

IEEE STD 446, Emergency and Standby Power Systems for Industrial and Commercial Applications (Orange Book)

MIL-STD-188-124B, Grounding, Shielding, and Bonding

Motorola Standards and Guidelines for Communication Sites, 68P81089E50-C, April 2017

National Energy Policy Act of 2005-SEC. 203. FEDERAL PURCHASE REQUIREMENT

NEMA FG 1, Fiberglass Cable Tray Systems - Revision No.1

NEMA VE 1, METAL CABLE TRAY SYSTEMS

NEMA VE 2, Cable Tray Installation Guidelines - Incorporates Errata 2016

NFPA 13, Standard for the Installation of Sprinkler Systems

NFPA 70, National Electrical Code®

NFPA 70E, Standard for Electrical Safety in the Workplace

NFPA 72, National Fire Alarm and Signaling Code

NFPA 75, Standard for the Fire Protection of Information Technology Equipment

NFPA 99, Healthcare Facilities Code

NFPA 101, Life Safety Code

NFPA 780, Standard for the Installation of Lightning Protection Systems

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

PG-18-12 OIT Design Guide, Office of Construction and Facilities Management Design Guide (Superseded. See Standards Alert 017 R01b)

Physical Security and Resiliency Design Manual

Presidential Memorandum 131205, "Federal Leadership on Energy Management"

UL 444, UL Standard for Safety Communications Cables - 5th Edition

UL 444 BULLETIN, UL Standard for Safety Communications Cables

VA DIRECTIVE 6008, ACQUISITION AND MANAGEMENT OF VA INFORMATION TECHNOLOGY ASSETS

VA DIRECTIVE 6500, INFORMATION SECURITY PROGRAM

VA Electrical Design Manual

VA Fire Protection Design Manual

VA HVAC Design Manual

VA Lighting Design Manual

VA OIT Design Guide

VA Operations and Maintenance Standard for Telecommunications Spaces (Pending publication)

VA Physical Security and Resiliency Design Manual

VA Sustainable Design Manual

VA Telecommunications and Special Telecommunications Systems Design Manual

VHA Directive 1061, Prevention of Healthcare-Associated Legionella Disease and Scald Injury from Potable Water Distribution Systems

C.5 Acronyms

For other acronyms and initialisms, VA employees and contractors with VA intranet access may refer to the full VA Acronym List. All others may inquire with Enterprise Data Center and Infrastructure Engineering (DCIE) at VAITESEDatacenterEngineering2@va.gov.

Table 50: Acronyms

Acronym	Definition
AC	Alternating Current
ACEG	Alternating Current Equipment Ground
AES	Advanced Encryption Standard
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
APC	Angled Physical Contact
ARU	Air Removal Units
ASD	Aspirated Smoke Detection
ASHRAE	American Society of Heating and Air-Conditioning Engineers
ATS	Automatic Transfer Switch
AWG	American Wire Gauge
BACnet	Building Automation and Control Networking Protocol
BAS	Building Automation System
BCM	Branch Circuit Monitoring
BCP	Branch Circuit Panelboard
BICSI	Building Industry Consulting Service International
BMS	Battery Monitoring System

Acronym	Definition
CAB	Change Advisory Board
CANbus	Controller Area Network Bus
CCTV	Closed Circuit Television
CDC	Core Data Center
CE	Clinical Engineering
CFD	Computational Fluid Dynamics
CFM	Cubic Feet Per Minute
CFM	VA Office of Construction and Facilities Management
CM	Communications
CMMS	Computerized Maintenance Management System
CMOP	Consolidated Mail Outpatient Pharmacy
CMP	Communications Plenum
CMR	Communications Riser
CPAC	Consolidated Patient Account Center
CRAC	Computer Room Air Conditioner
CRAH	Computer Room Air Handler
CSC	Campus Support Center
DAS	Distributed Antenna System
DC	Direct Current
DCIE	Data Center and Infrastructure Engineering
DCIM	Data Center Infrastructure Management

Acronym	Definition
DR	Disaster Recovery
DX	Direct Expansion
EBSR	Enterprise Baseline and Standard Review
EC	Electronically Commutated
ED	Equipment Distributor
EDICT	Enterprise Data Center Infrastructure Collaboration Team
EDM	Electrical Design Manual
EGS	Earth Ground System
EIA	Electronic Industries Alliance
EMCS	Energy Management Control System
EPO	Emergency Power Off
ESD	Electrostatic Discharge
DX	Direct Expansion
FB	Front Bottom
FCU	Fan Coil Units
FEC	Facility Total Electrical Consumption
FM	Front Middle
FMS	Facilities Management Service
FPDM	Fire Protection Design Manual
FSC	Financial Services Center
FSS	Facilities Standards Service

Acronym	Definition
FT	Front Top
GbE	Gigabit Ethernet
Gb/s	Gigabit per second
HAC	Health Administration Center
HCC	Health Care Centers
HEC	Health Eligibility Center
HD	High Density
HDA	Horizontal Distribution Area
HF	High Frequency
HVAC	Heating, Ventilation, and Air Conditioning
IACS	International Annealed Copper Standard
IAW	In Accordance With
ICC	Intermediate Cross Connect
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IO	Infrastructure Operations
ISP	Inside Plant
IT	Information Technology
ITOPS	IT Operations and Services
ITS	Information Transport Systems
LAN	Local Area Network

Acronym	Definition
LED	Light Emitting Diode
LFMC	Liquid-tight Flexible Metal Conduit
LP	Limited Power
LPS	Lightning Protection System
MATV	Master Antenna Television
MCC	Main Cross Connect
MM	Multimode
MPDU	Master Power Distribution Unit
MPO	Multi-Fiber Push On
MSC	Mission Support Center
NCA	National Cemetery Administration
NDCOL	National Data Center Operations and Logistics
NEC®	National Electrical Code®
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSC	Network Support Center
O&M	Operations and Maintenance
OIFO	Office of Information Field Office
OIT	Office of Information and Technology
OM	Optical Multimode
OMB	Office of Management & Budget

Acronym	Definition
OPC	Outpatient Clinic
PA	Public Address
PBB	Primary Bonding Busbar
PDU	Power Distribution Unit
PoE	Power-over-Ethernet
PVC	Polyvinyl Chloride
PS	Power Supply
PUE	Power Usage Effectiveness
R&D	Research & Development
RB	Rear Bottom
RBB	Rack Bonding Busbar
RBC	Rack Bonding Conductor
RCDD	Registered Communications Distribution Designer
RDC	Regional Data Center
RDC	Remote Distribution Cabinet
RED	Radio Entertainment Distribution
RF	Radio Frequency
RH	Relative Humidity
RM	Rear Middle
rPDU	Rack Power Distribution Unit
RPS	Radio Paging System

Acronym	Definition
RT	Rear Top
RT	Refrigeration Ton
RU	Rack Unit
SBB	Secondary Bonding Busbar
SAN	Storage Area Network
SD	Standard Density
SIEER	Site Infrastructure Energy Efficiency Rating
SM	Single-mode
SSL	Secure Sockets Layer
SSTV	Security Surveillance Television
SWDM	Short Wavelength Division Multiplexing
TBB	Telecommunication Bonding Backbone
TEBC	Telecommunications Equipment Bonding Conductor
TEC	Total Data Center Energy Consumption
TIA	Telecommunications Industry Association
TIL	Technical Information Library
TITEC	Total IT Equipment Energy Consumption
TPIEC	Total Data Center Physical Infrastructure Energy Consumption
TR	Telecommunications Room
TUPSC	Total UPS Load Energy Consumption
TVRO	Television Receive Only Master Antenna Satellite Television

Acronym	Definition
UBC	Unit Bonding Conductor
UL	Underwriters Laboratories Inc
UTP	Unshielded Twisted Pair
VA	Department of Veterans Affairs
VAMC	Veterans Affairs Medical Center
VACO	VA Central Office
VBA	Veterans Benefits Administration
VED	Vertical Exhaust Duct
VESDA	Very Early Smoke Detection Apparatus
VHA	Veterans Health Administration
VLA	Vented Lead Acid
VRLA	Valve Regulated Lead Acid
VSAT	Very Small Aperture Terminal
VSD	Variable Speed Drive
VSS	Video Surveillance Systems
WC	Water Column
zPDU	Zone Power Distribution Unit

C.6 Contributors

This Standard is maintained by the Enterprise Data Center Infrastructure Collaboration Team (EDICT).

Contributors to the development of this document are as follows:

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Myra Coffield	Section 508 Office	Technical Writing, CommonLook Office

U. S. Department of Veterans Affairs

Office of Information and Technology

Infrastructure Operations (IO)

OIT Design Guide Templates for Critical Infrastructure in Telecommunications Spaces (Clinical and Non-Clinical Environments)

DEVELOPED BY:
DATA CENTER AND INFRASTRUCTURE ENGINEERING

Department of Veterans Affairs

Office of Information and Technology

Infrastructure Operations - Application Hosting, Cloud and Edge Solutions

Enterprise Data Center and Infrastructure Engineering

EDICT

Enterprise Data Center Infrastructure Collaboration Team

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SHEET TITLE

Cover

LEGEND

ELECTRICAL

- # — Detail Number
- # TYP — Detail Number, typical throughout this sheet
- Bonding busbar
- Wire mesh cable tray size commensurate with requirements
- Electrical service panel
- Overhead power drop cord with L21-20 receptacle
- Overhead power drop cord with L21-30 receptacle
- J — Power junction box for 60 A connection
- Power busway tap with single breaker 3 ft drop cord with L21-20R for standard-density cabinets
- Power busway tap with dual breakers and qty two 3 ft drop cords with L21-20R for high-density cabinets
- Typical unswitched 110 V, 20 A duplex convenience outlet
- Motion sensor light switch
- M — Ceiling mounted motion sensor (locations as required for full room coverage)
- PIV enabled two-factor authentication keypad
- Fixed camera, pan/tilt/zoom, passive infrared camera - dual technology
- LED lighting
- Power busway with metered headend for A-side power distribution
- Power busway with metered headend for B-side power distribution
- UPS — Modular UPS cabinet (power modules, batteries, power panels)

TELECOMMUNICATIONS

- # — Detail number
- # TYP — Detail number, typical throughout this sheet
- Wire mesh cable tray size commensurate with requirements
- Conduit with bushing firestop and innerduct for fiber
- Sleeve with bushing firestop and innerduct for fiber
- Sleeve or conduit with bushing firestop and innerduct for fiber
- Telecommunications channel rack, 19 in. rails, #12-24 tapped EIA hole pattern, 30 in. deep channel minimum, 7 ft high, 45 RU, white
- Vertical cable manager with door, 6 in. wide minimum (sized to meet requirement)
- Server cabinet, 45 RU, 24 in. x 48 in. (nominal), square punched rail, single perforated front door, solid rear door (vertical exhaust duct [VED] implementation), double perforated rear door (no VED), two-point keyed locks, white, solid side panels
- Telecommunications cabinet, 84 in. high, 44 RU, 24 in. x 42 in. (nominal), square punched rail, single perforated front door, solid rear door (vertical exhaust duct [VED] implementation), double perforated rear door (no VED), white, solid side panels, shown with two 12 in. vertical cable management sidecars (6 in. versions available)

ARCHITECTURAL

- 4 ft by 8 ft AC grade ¾ in. trade size plywood backboard painted high-gloss white with two coats of fire resistant paint for service provider / security / video / et cetera
- 3 ft wide, 8 ft high door, fire resistant to ¾ hour or more per authority having jurisdiction (AHJ); door swing representative only
- 6 ft wide, 8 ft high door, no center mullion or removable mullion, fire resistant to ¾ hour or more per AHJ; door swing representative only
- 30 in. wide by 36 in. front clearance required around electrical panel boards
- 36 in. clearance required around front, back, and sides of racks and cabinets

MECHANICAL

- Standard 25% open perforated floor tile
- Grate floor tile
- Cold aisle containment PVC curtain
- Cold aisle containment area
- CRAC — Computer Room Air Conditioner (CRAC) (see computational fluid dynamics required for sizing)
- Required clearance around CRACs (size varies depending upon CRAC manufacturer)
- AC — Split package air conditioner or equivalent 24/7 supply air to reject 17,000 BTU/h (5 kW) per telecommunications rack
- T — Air conditioner thermostat

NOTES

ELECTRICAL

1. Minimum qty two 120 V 20 A convenience power outlets per wall; placement determined by others
2. Primary bonding busbar; placement determined by others
3. Secondary bonding busbar; placement determined by others
4. Service panel for A-side power, generator backed if the facility has generation capabilities. Shall be equipped with power meter; placement per others
5. Service panel for B-side power, generator backed if possible. Shall be equipped with power meter; placement per others
6. 20 A 208 V three-phase twist lock receptacle (L21-20R); 8.5 ft AFF (WYE (5-wire)) coordinate installation location with telecommunications contractor
7. 30 A 208 V three-phase twist lock receptacle (L21-30R); 8.5 ft AFF (WYE (5-wire)) coordinate installation location with telecommunications contractor
8. Power busway (voltage and amperage to support adequate single & double breaker 208 V, 20 A, L21-20R busway taps per server row) fed from A-side source
9. Power busway (voltage and amperage to support adequate single & double breaker 208 V, 20 A, L21-20R busway taps per server row) fed from B-side source
10. Power busway (voltage and amperage sufficient to support adequate single breaker 208 V, 20 A, L21-20R busway taps per network row) fed from A-side source
11. Power busway (voltage and amperage sufficient to support adequate 208 V, 20 A, L21-20R busway taps per network row) fed from B-side source
12. Blue cable patch for A-side UPS
13. Yellow cable path for B-side UPS

Lighting:
1. LED lighting placed in aisles directly in front of and behind cabinet rows
2. Lighting operated by motion sensor per cabinet row or section
3. 500 lumens in the horizontal plane and 200 lumens in the vertical plane required measured at 3 ft AFF in front of and behind equipment cabinets

TELECOMMUNICATIONS

1. Service provider entrance point
2. Service backbone – entrance room-Main Computer Room (MCR) with dual redundant pathways
3. Main cross connect (campus/building distributor) – backbone cabling (MCR-telecommunications rooms)
4. Entrance room interconnect
5. Horizontal distribution to work area outlets (WAO)
6. Additional cabinets or telecommunications racks to meet requirements
7. Horizontal distribution area (HDA) – side A
8. Horizontal distribution area – side B
9. Main distribution area (MDA) – side A
10. Main distribution area – side B
11. Standard density (SD) cabinet supporting 5 kW redundant
12. High density (HD) cabinet supporting 10 kW redundant
13. Network cabinet with vertical cable management sidecars, supporting 5 kW redundant
14. Wire mesh cable tray minimum of 4 in. x 12 in. with second level of fiber channel pathway (4 in. x 4 in.)
15. Blue cable tray path for cables to the A-side MDA/HDA
16. Yellow cable tray path for cables to the B-side MDA/HDA
17. Network channel rack

ARCHITECTURAL

Floor to ceiling height:
1. Telecommunication rooms including network support centers: Maximum extent possible
2. Data centers excluding extra small network support centers: Minimum 16 ft slab to deck above

Floor composition:
1. Electrostatic Discharge (ESD) coating for raised floor systems Static dissipative coating or material for slab floors
2. Concrete slab 5 in. thickness at ground
3. Steel deck and fill for floors above ground
4. Avoid access floor plenums for air distribution purposes

Walls: full height to deck above for all telecommunication spaces

Ceilings: no suspended ceilings allowed

Data center size allocation per chart below:

Data Center Size	Square Footage	Form Factor
Extra Small	775 (785)	24 ft x 32.5 ft (20 ft x 39.25 ft)
Small	1152	24 ft x 48 ft
Medium	1760	40 ft x 44 ft

Contact data center and infrastructure engineering (VAITESEDatacenterEngineering2@va.gov) to determine what size data center is required for your facility

Floorplans are not to scale (NTS)
Documents are not to be used for construction

MECHANICAL

Changes to design will require a new Computational Fluid Dynamics (CFD) analysis to be performed

Department of Veterans Affairs
Office of Information and Technology
Infrastructure Operations - Application Hosting, Cloud and Edge Solutions
Enterprise Data Center and Infrastructure Engineering
EDICT
Enterprise Data Center Infrastructure Collaboration Team

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Legend

TELECOMMUNICATIONS SPACES (ARCHITECTURAL)

DEPARTMENT OF VETERANS AFFAIRS

OFFICE OF INFORMATION AND TECHNOLOGY

INFRASTRUCTURE OPERATIONS - APPLICATION HOSTING, CLOUD AND EDGE SOLUTIONS

ENTERPRISE DATA CENTER AND INFRASTRUCTURE ENGINEERING

EDICT

ENTERPRISE DATA CENTER INFRASTRUCTURE COLLABORATION TEAM

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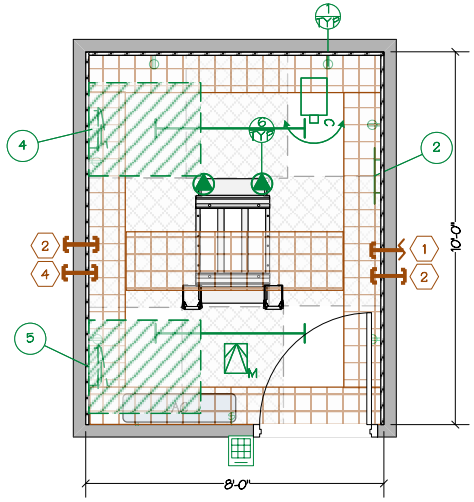
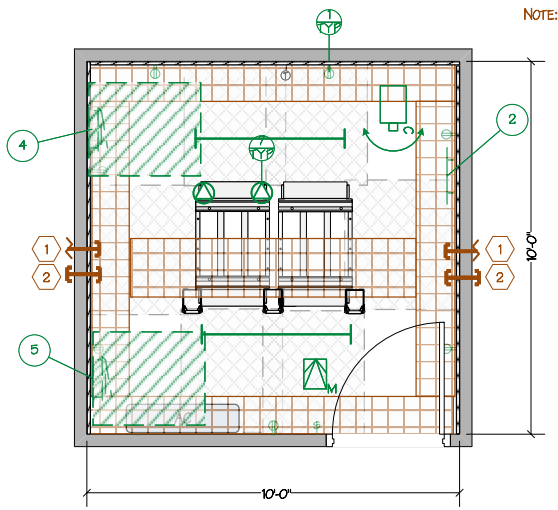
TELECOMMUNICATIONS SPACES (ARCHITECTURAL)



3 GENERIC FLOOR PLAN FOR ENTRANCE ROOM (ONE SERVICE PROVIDER)
NOT FOR HEALTHCARE ENVIRONMENTS

NOTE: TWO ENTRANCE ROOMS ARE REQUIRED FOR EACH VA CAMPUS SUPPORTED BY A CDC OR CSC



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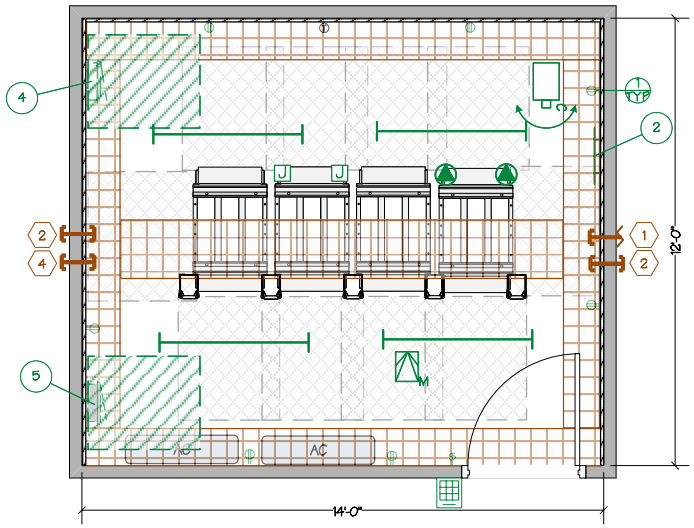
NOT FOR HEALTHCARE ENVIRONMENTS



2 GENERIC FLOOR PLAN FOR HEALTHCARE ENTRANCE ROOM
TWO REQUIRED PER CAMPUS (CAN ALSO ACT AS A TR FOR A SERVING ZONE)

NOTE:

THREE FT CLEARANCE FROM WALL MOUNTED EQUIPMENT MUST BE MAINTAINED.

30 IN. WIDE BY 36 IN. FRONT CLEARANCE REQUIRED AROUND ELECTRICAL PANEL BOARDS

36 IN. CLEARANCE REQUIRED AROUND FRONT, BACK, AND SIDES OF RACKS AND CABINETS

TWO L21-20 BRANCH CIRCUITS PER RACK CAN BE USED FOR ALL RACKS ELIMINATING THE NEED FOR ZONE PDUS IF BREAKER SPACE IS NO AN ISSUE (ALTERNATIVELY, ZPDUS CAN SUPPORT EITHER TWO OR THREE RACKS EACH)

1 TELECOMMUNICATION ENTRANCE ROOM NOTES

DEPARTMENT OF VETERANS AFFAIRS

OFFICE OF INFORMATION AND TECHNOLOGY

INFRASTRUCTURE OPERATIONS - APPLICATION HOSTING, CLOUD AND EDGE SOLUTIONS

ENTERPRISE DATA CENTER AND INFRASTRUCTURE ENGINEERING

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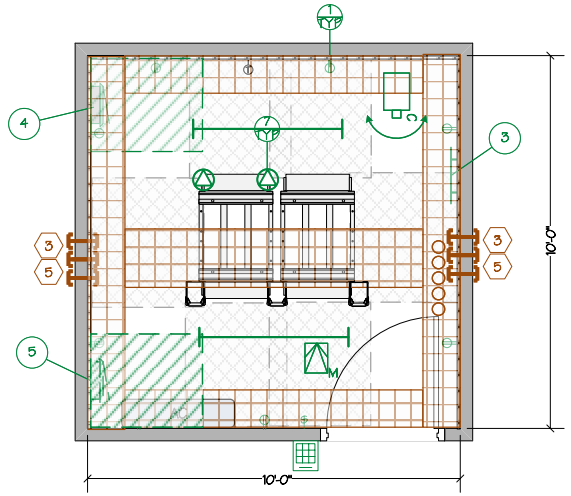
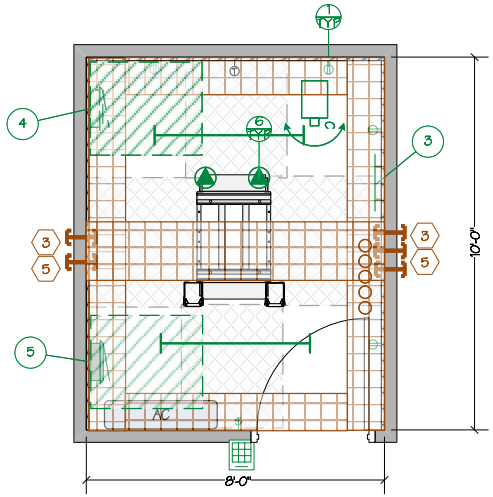
TELECOMMUNICATION ENTRANCE ROOMS



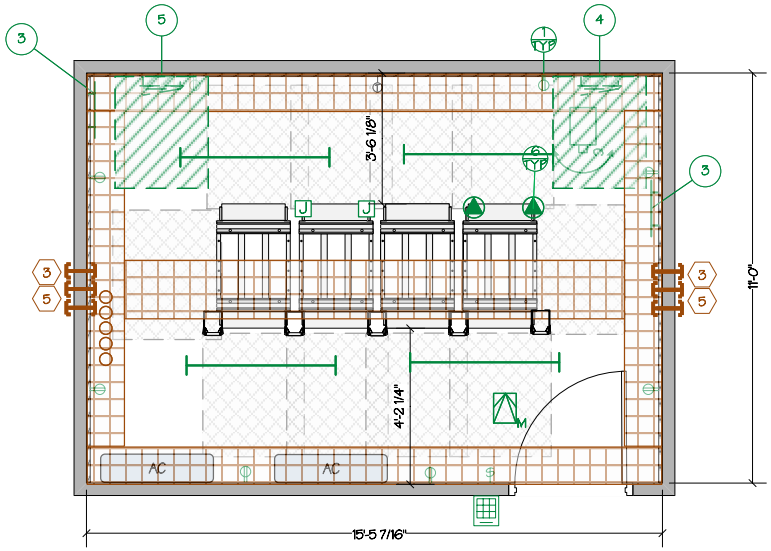
GENERIC FLOOR PLAN FOR TELECOMMUNICATIONS ROOMS (TWO RACK REQUIREMENT)
(TELECOMMUNICATIONS SPACE SUPPORTING NETWORK DISTRIBUTION TO WORK AREA OUTLETS)
MINIMUM REQUIREMENT FOR HEALTHCARE FACILITY REMODELS

3



GENERIC FLOOR PLAN FOR TELECOMMUNICATIONS ROOMS (ONE RACK REQUIREMENT)
(TELECOMMUNICATIONS SPACE SUPPORTING NETWORK DISTRIBUTION TO WORK AREA OUTLETS)

4



GENERIC FLOOR PLAN FOR HEALTH CARE FACILITY TELECOMMUNICATIONS ROOMS

2

NOTE:

- THERE SHALL BE A MINIMUM OF ONE TELECOMMUNICATIONS ROOM (TR) PER FLOOR.
- ADDITIONAL ROOMS SHOULD BE PROVIDED WHEN THE HORIZONTAL DISTRIBUTION DISTANCE TO THE WORK AREA EXCEEDS 90 M (295 FT) OR THE ROOM SIZE CAN'T SUPPORT ALL WORK AREA OUTLETS.

FLOOR SPACE REQUIREMENT:

1. MINIMUM OF 80 FT² FOR A ONE RACK TR
2. ADD AN ADDITIONAL 20 FT² PER ADDITIONAL RACK
3. MINIMUM OF 170 FT² FOR A HEALTH CARE FACILITY TR
4. TWO L21-20 BRANCH CIRCUITS PER RACK CAN BE USED FOR ALL RACKS ELIMINATING THE NEED FOR ZPDUS IF BREAKER SPACE IS NOT AN ISSUE (ALTERNATIVELY, ZPDUS CAN SUPPORT EITHER TWO OR THREE RACKS EACH)
5. 3 FT OF CLEARANCE ON THREE SIDES OF THE RACKS MUST BE MAINTAINED
6. THE FOURTH SIDE AT THE END OF A ROW MUST BE AT LEAST 12 IN FROM THE WALL
7. 3 FT OF CLEARANCE MUST BE MAINTAINED FROM ANY WALL-MOUNTED EQUIPMENT TO THE RACKS AS WELL
8. 30 IN. WIDE BY 36 IN. FRONT CLEARANCE REQUIRED AROUND ELECTRICAL PANEL BOARDS

A MINIMUM OF FIVE METRIC DESIGNATOR 103 (TRADE SIZE 4) CONDUITS OR SLEEVES SHOULD BE PROVIDED TO SERVICE UP TO 40,000 FT² OF USABLE FLOOR SPACE. ONE ADDITIONAL CONDUIT OR SLEEVE SHOULD BE PROVIDED FOR EACH ADDITIONAL 40,000 FT² OF USABLE FLOOR SPACE

EACH RACK MUST BE CAPABLE OF SUPPORTING 5 KW OF LOAD. HOWEVER, IN AGGREGATE FOR TRS WITH MORE THAN ONE RACK, THE FULL 5 KW OF HEAT REJECTION PER RACK IS NOT REQUIRED. SEE BELOW:

- 1 RACK TR = 5 KW COOLING
- 2 RACK TR = 7 KW COOLING
- 3 RACK TR = 8.5 KW COOLING
- 4 RACK TR = 10 KW COOLING

TELECOMMUNICATION ROOM NOTES

1

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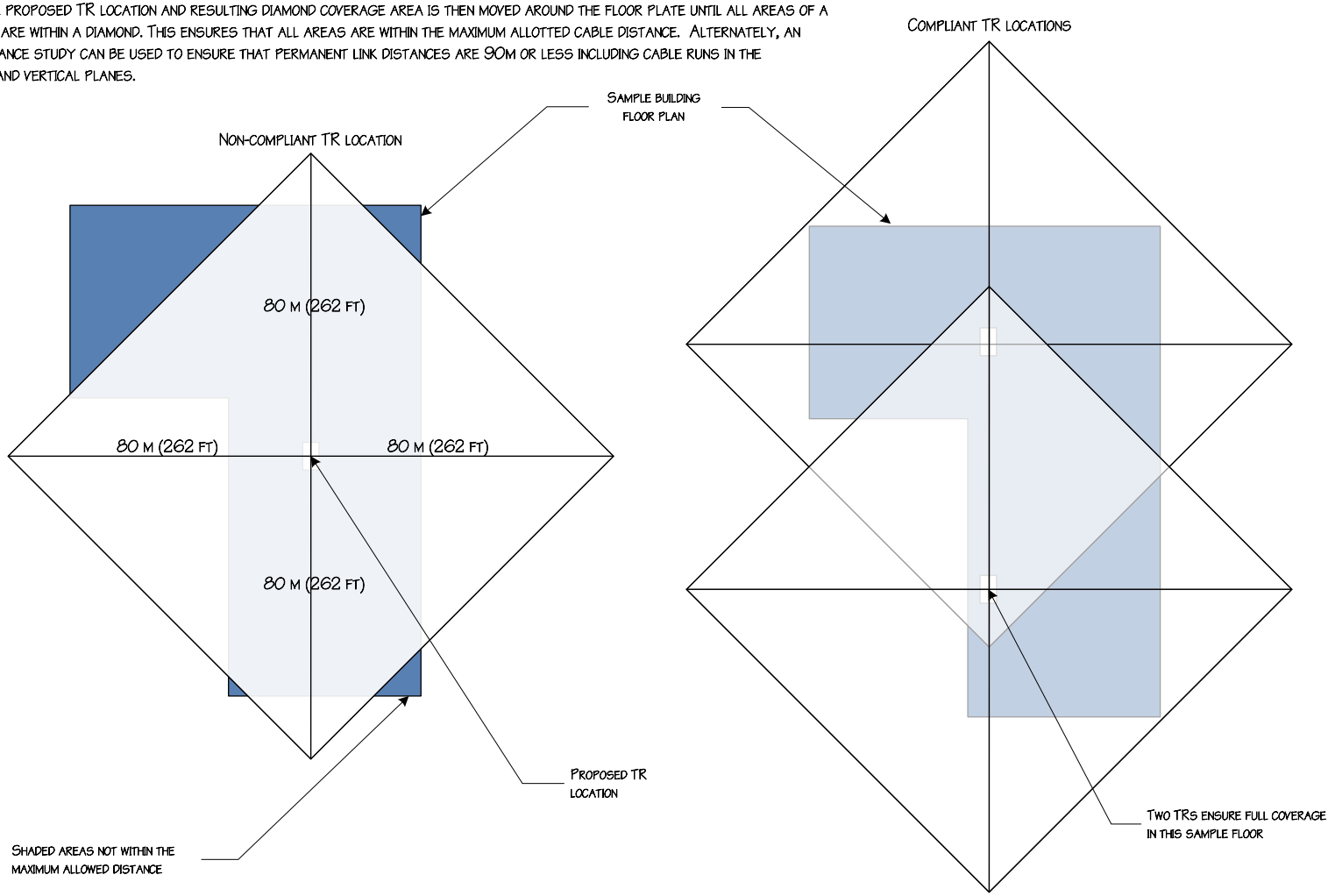
SHEET TITLE
TELECOMMUNICATIONS ROOMS

A horizontal cable distance study is one approach to define telecommunications room (TR) locations. The study locates the TR in the proposed location and draws four straight 262 foot (80 m) lines originating at the center of the room, to the North, South, East and West, and then connects the ends of the four lines together, creating a "diamond," with the proposed TR location at the center. The proposed TR location and resulting diamond coverage area is then moved around the floor plate until all areas of a given floor are within a diamond. This ensures that all areas are within the maximum allotted cable distance. Alternately, an actual distance study can be used to ensure that permanent link distances are 90m or less including cable runs in the horizontal and vertical planes.



1 Horizontal cable distance study (diamond analysis) for telecommunication room location planning
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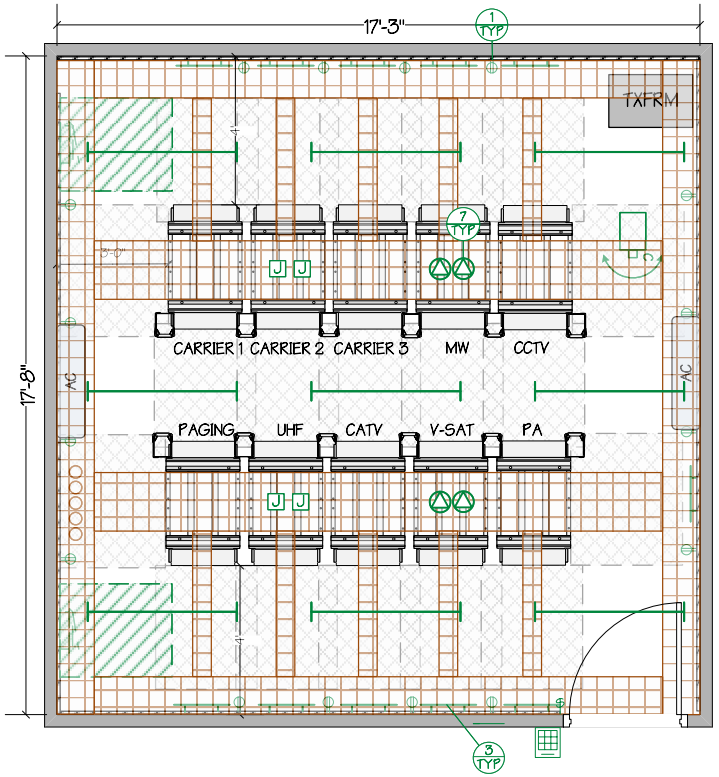
Horizontal Cable Distance Study (Diamond Analysis)



NOTE:

THE ANTENNA ENTRANCE ROOM (AKA ANTENNA HEADEND EQUIPMENT ROOM) SHALL BE LOCATED IN THE MECHANICAL PENTHOUSE OR OTHER AREA DICTATED BY SYSTEM DESIGN AND AS CLOSE TO THE ANTENNA FARM AS POSSIBLE. THE ROOM SHALL ACCOMMODATE ALL PROVIDED AND PLANNED FMS RADIO FREQUENCY BASED (RF) SPECIAL SYSTEMS AND HEADEND EQUIPMENT CABINETS (I.E., DAS, MATV, M/W, HF, V-SAT, TVRO, SSV, RED, PA, TWO-WAY RADIO, RPS, ETC.)

THE ROOM SHALL BE DESIGNED TO SUPPORT RF HEADEND EQUIPMENT FOR A MINIMUM OF SIX SEPARATE SYSTEMS, FOUR FUTURE SYSTEMS, OVERHEAD AND WALL WIRE MANAGEMENT SYSTEMS, WEATHERPROOF WALL/CEILING CABLE FEEDTHROUGHS, AND CONDUITS

SYSTEM LAYOUT IS NOTIONAL AND DEPENDS UPON SITE REQUIREMENTS

30 IN. WIDE BY 36 IN. FRONT CLEARANCE REQUIRED AROUND 120/208 V ELECTRICAL PANEL BOARDS

FOUR FOOT CLEARANCE REQUIRED BEHIND RACKS TO ALLOW FOR 12 IN. OF WALL-MOUNTED EQUIPMENT

TWO L21-20 BRANCH CIRCUITS PER RACK CAN BE USED FOR ALL RACKS ELIMINATING THE NEED FOR ZONE PDUS IF BREAKER SPACE IS NOT AN ISSUE (ALTERNATELY, ZPDUS CAN SUPPORT EITHER TWO OR THREE RACKS EACH)

1 ANTENNA ENTRANCE ROOM

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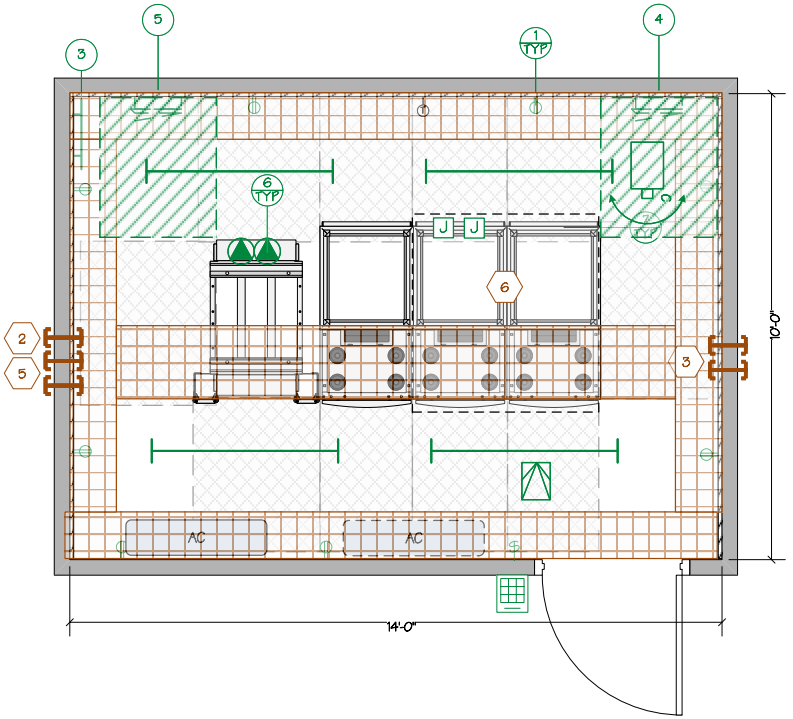
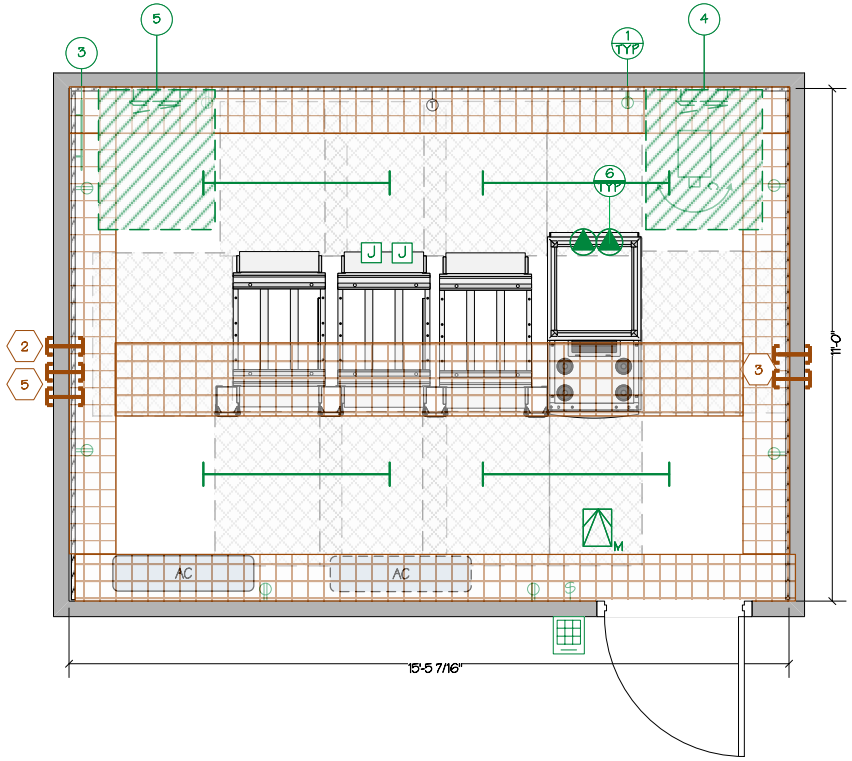
ANTENNA ENTRANCE ROOM



2 GENERIC FLOOR PLAN FOR NETWORK SUPPORT CENTERS
COMPOSITION OF SERVER CABINETS AND NETWORK RACKS DEPENDENT UPON SITE REQUIREMENT



1 GENERIC FLOOR PLAN FOR HEALTH CARE FACILITY EQUIPMENT ROOM (NETWORK SUPPORT CENTER)
COMPOSITION OF SERVER CABINETS AND NETWORK RACKS DEPENDENT UPON SITE REQUIREMENT

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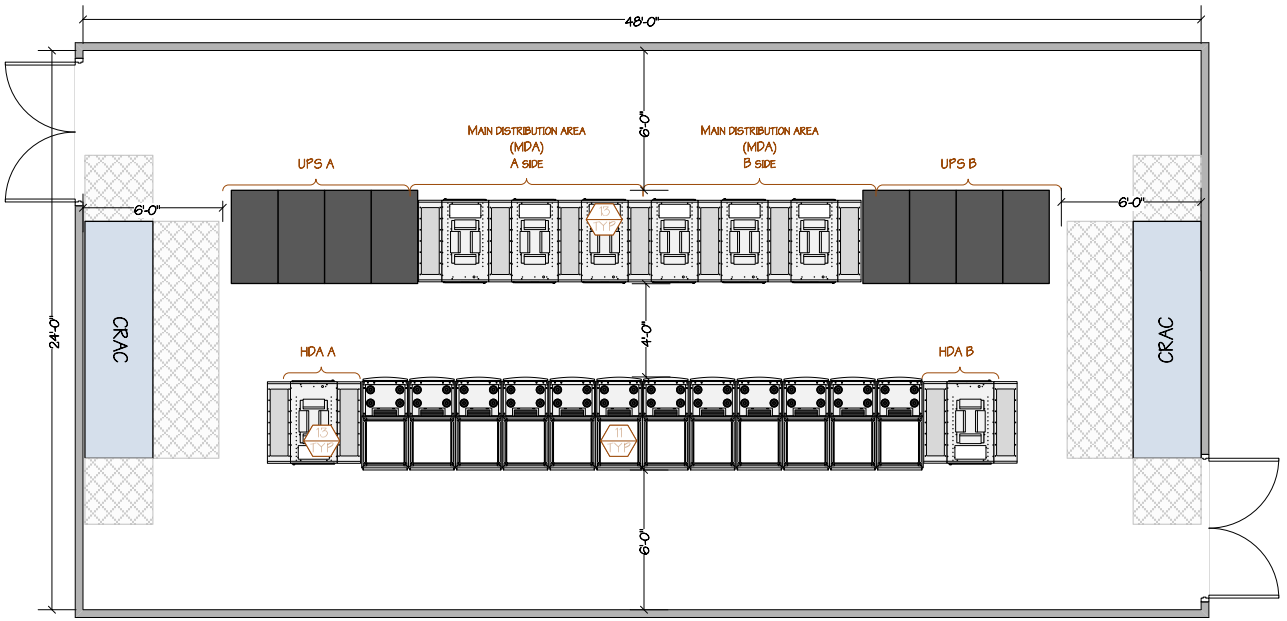
NETWORK SUPPORT CENTER



NOTE: SEE THE GENERIC SMALL CAMPUS SUPPORT CENTER (DATA CENTER) DESIGN PORTFOLIO PACKAGE FOR DETAILED IMPLEMENTATION INSTRUCTIONS

1 GENERIC FLOOR PLAN FOR SMALL DATA CENTERS (1,152 FT²)

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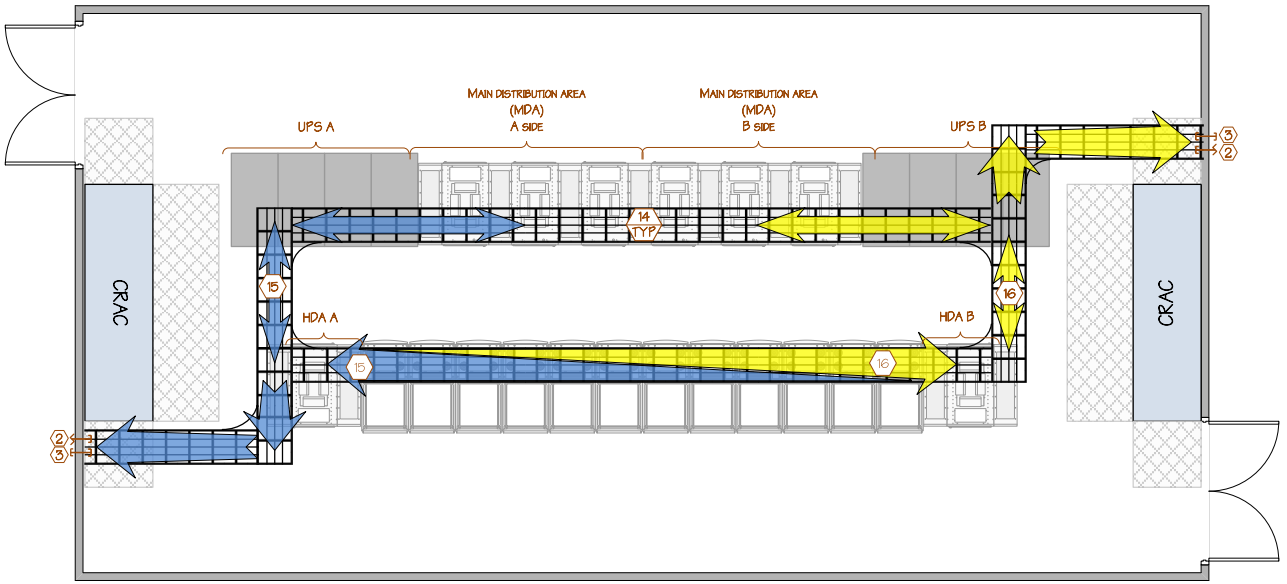
SMALL DATA CENTER



NOTE: SEE THE GENERIC SMALL CAMPUS SUPPORT CENTER (DATA CENTER) DESIGN PORTFOLIO PACKAGE FOR DETAILED IMPLEMENTATION INSTRUCTIONS

1 SMALL DATA CENTER - DATA CABLE TRAY LAYOUT

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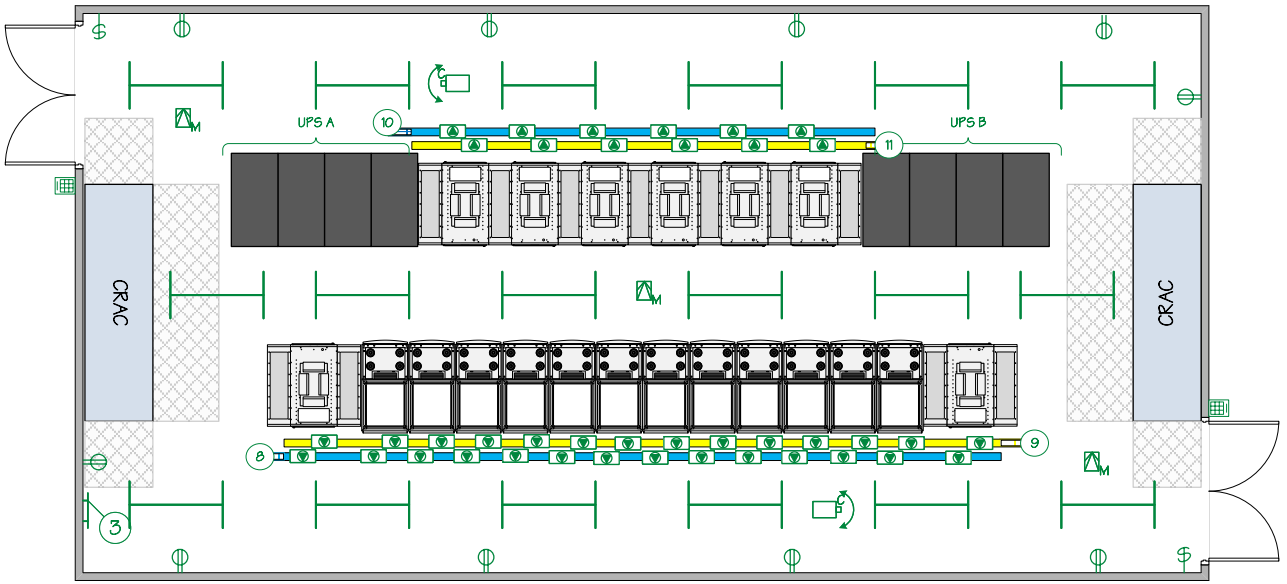
SMALL DATA CENTER - PATHWAY DETAILS



NOTE: SEE THE GENERIC SMALL CAMPUS SUPPORT CENTER (DATA CENTER) DESIGN PORTFOLIO PACKAGE FOR DETAILED IMPLEMENTATION INSTRUCTIONS

1 GENERIC FLOOR PLAN FOR SMALL DATA CENTERS – POWER PLAN (72.9 W/FT²)

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SMALL DATA CENTER - POWER

TELECOMMUNICATIONS ENCLOSURES

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TELECOMMUNICATIONS ENCLOSURE

ID	Primary Attribute	Secondary Attribute	Specification
1	Construction of TEs	Shell	• NEMA-12 or equivalent • Tempered glass front door • Dust seals and replaceable inlet/outlet vents/airflow openings/fans
		Access	• Cabinet swings open to access rear of installed equipment • Swinging front door to access front of installed equipment • Both sections able to be physically locked
		Racking Rails	EIA-310-D 19 in. front and rear adjustable rails
		Height	• 12 RU for up to 48 Work Area Outlets (WAOs) • 26 RU for up to 96 WAOs
		Width	24 in. minimum
		Depth	30 in. minimum
		Mounting	16 in. on-center for standard stud construction
		Heat dissipation	120 V fans
2	Outfitting of TEs	Input Power	A/B redundant L5-30 120 V 30 A circuits
		UPS	• Rack-mounted 2880VA metered L5-30 input/output • Dual/delta conversion not required • Connected to A-side input power circuit
		Rack Power Distribution	• A/B redundant 1 RU horizontal rack-mounted PDUs • L5-30 input, minimum 8 each 5-15R or 5-20R outlets
		Fiber Backbone	• 1 RU fiber distribution cabinet • Flat cabinet authorized
		Horizontal Distribution	• 1 RU UTP patch panels • Flat patch panels authorized • Maximum 1 patch panel for 12 RU TE, two patch panels for 26 RU TE
		Network Switches	• Standard 1 RU 48-port network switches • Maximum 1 switch for 12 RU TE, two switches for 26 RU TE
		IT Equipment Power Cord Color Code	• A-side: Black • B-side: A distinctly different color (white or gray preferred) • Differentiated by source bus (jacket or other marking) • Comply with any established local color schema
		IT Equipment Power Cord Type	• 120 V 15 A • C13 at IT equipment power supply and NEMA 5-15 at Rack PDU
		Bonding	Standard equipment and interconnections as per a TR and network channel rack

1 Attributes and salient characteristics for Telecommunications Enclosures (TEs)
NTS

Wall-mount TE Salient Characteristics

- NEMA-12 or equivalent construction. Dust seals and replaceable inlet/outlet filters for vents/airflow openings/fans provided. This is required regardless of planned installation environment.
- Filters shall be commercially widely available and initially provided with the TE.
- Environmentally controlled enclosures are acceptable; consider when the conditions where the TE is to be installed are outside of allowable TR environmental limits.
- 24 in. minimum width to allow for power and telecommunications cabling management to the sides of rack-mounted equipment.
- 30 in. minimum depth to allow for structured cabling and power distribution at the rear of the rack.
- Full-height TEs shall be 26 RU in height or larger as needed to meet the specific implementation requirements. Half-height TEs shall be a minimum of 12 RU in height (24 in.).
- Unit mounts to ¾ in. plywood backboard via 16 in. on center (OC) mounting for standard stud construction.
- Unit opens in rear (swings open) for access to rear of installed equipment. Unit opens in front (swinging front door) for access to front of installed equipment. Both sections are able to be physically locked.
- Adjustable 19 in. EIA/TIA rack rails. Rear rail kits are required.
- Top and bottom knockouts for cable/conduit entry. All knockouts must be sealable and sealed for liquid and dust entry resistance. The use of a knockout kit to create larger penetrations is acceptable.
- 120 V fans to remove heat generated in TE are required. Whether these are used as exhaust, intake, or both is not specified.
- Provide TEs with fiber distribution cabinets, fiber cassettes, UTP patch panels, horizontal cable management units, and shelves as required for the specific implementation.

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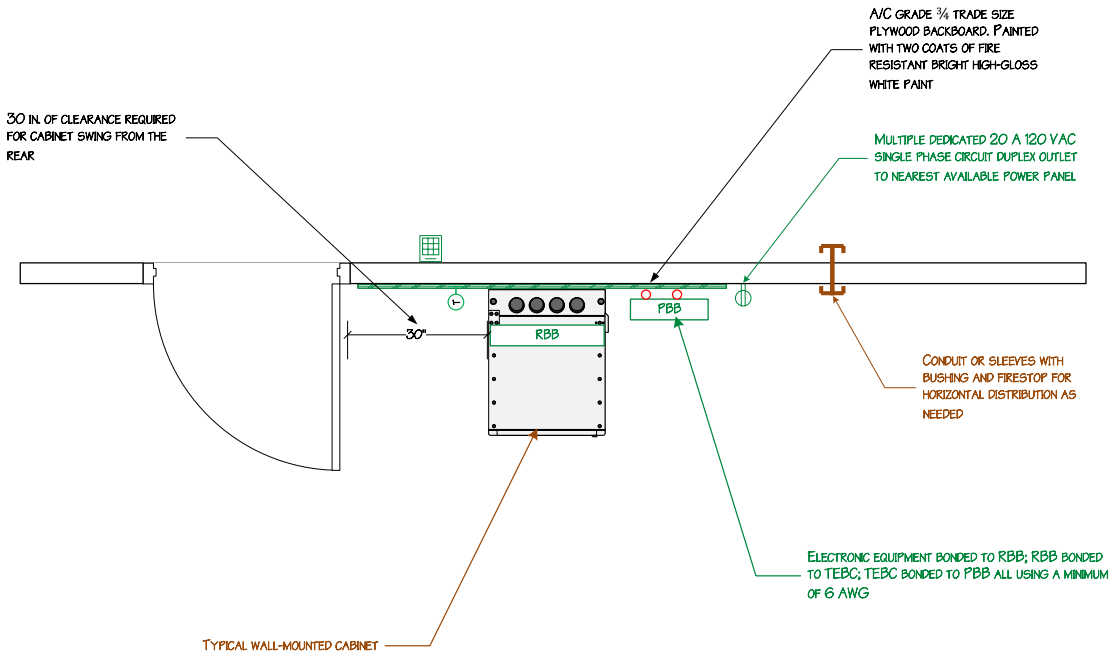
Telecommunications Enclosure Attributes



1 TYPICAL TOP-DOWN VIEW
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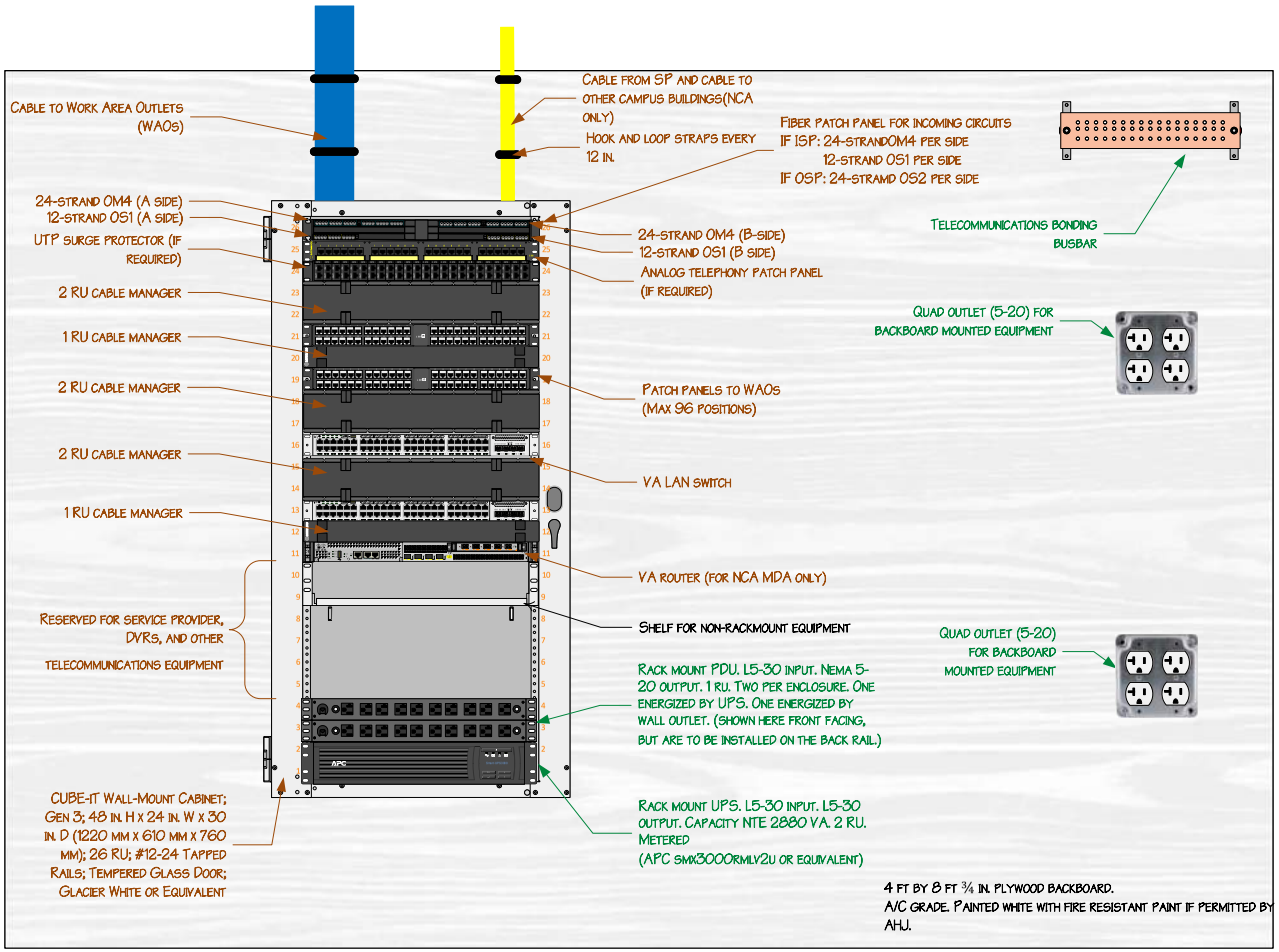
TELECOMMUNICATIONS ENCLOSURE TOP VIEW

LOCKING 120 V 30 A OUTLETS (L5-30) ON THE WALL BEHIND THE RACK ALIGNED WITH THE CUTOUT ON THE ENCLOSURE. ONE OUTLET ASSIGNED TO PDU. ONE OUTLET ASSIGNED TO UPS. EACH ENERGIZED BY SEPARATE ONE-POLE 30 A BREAKERS.



1 ELEVATION FOR 26 RU ENCLOSURE
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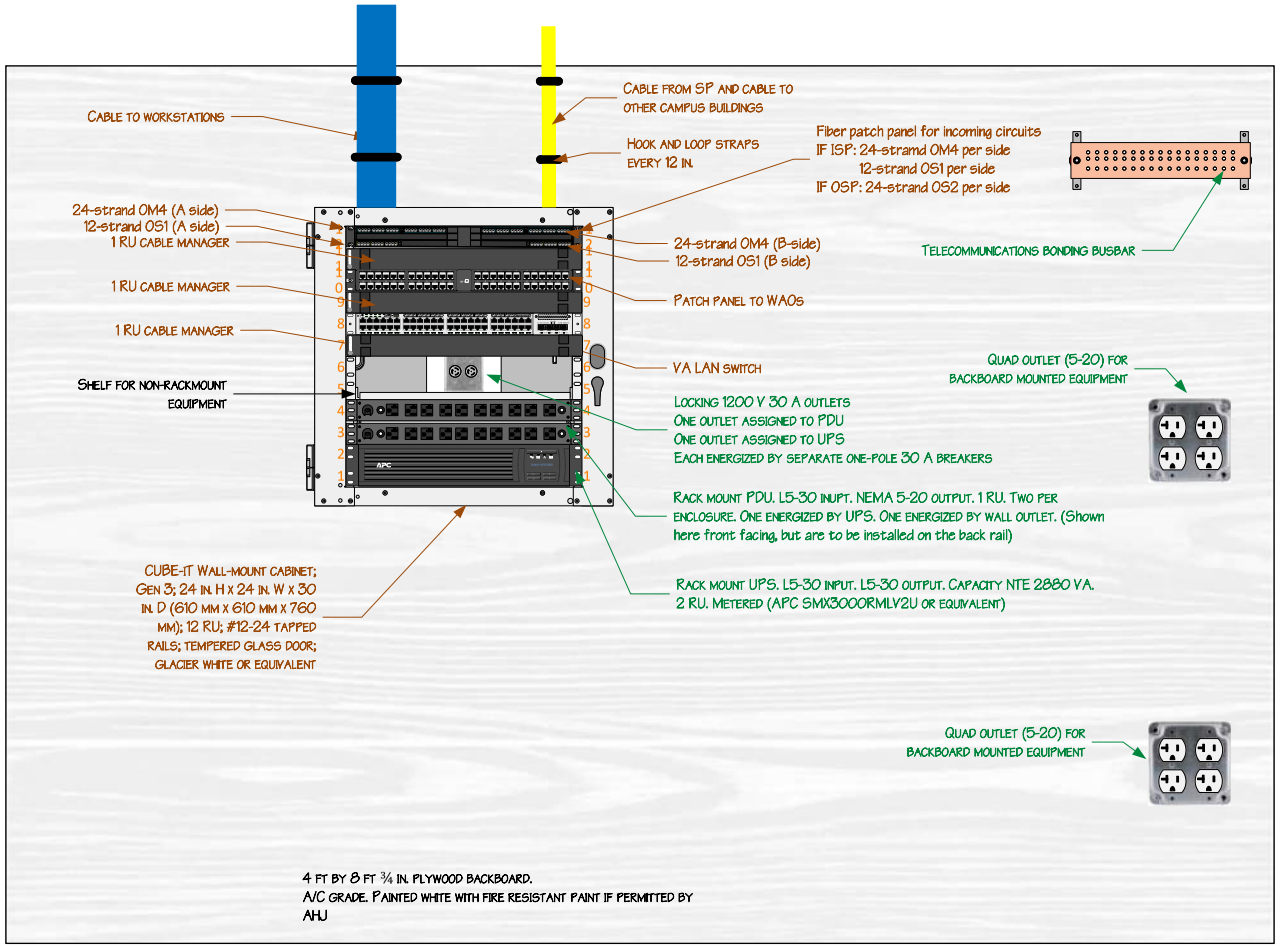
TE 26RU ELEVATION



1 ELEVATION FOR 12 RU ENCLOSURE
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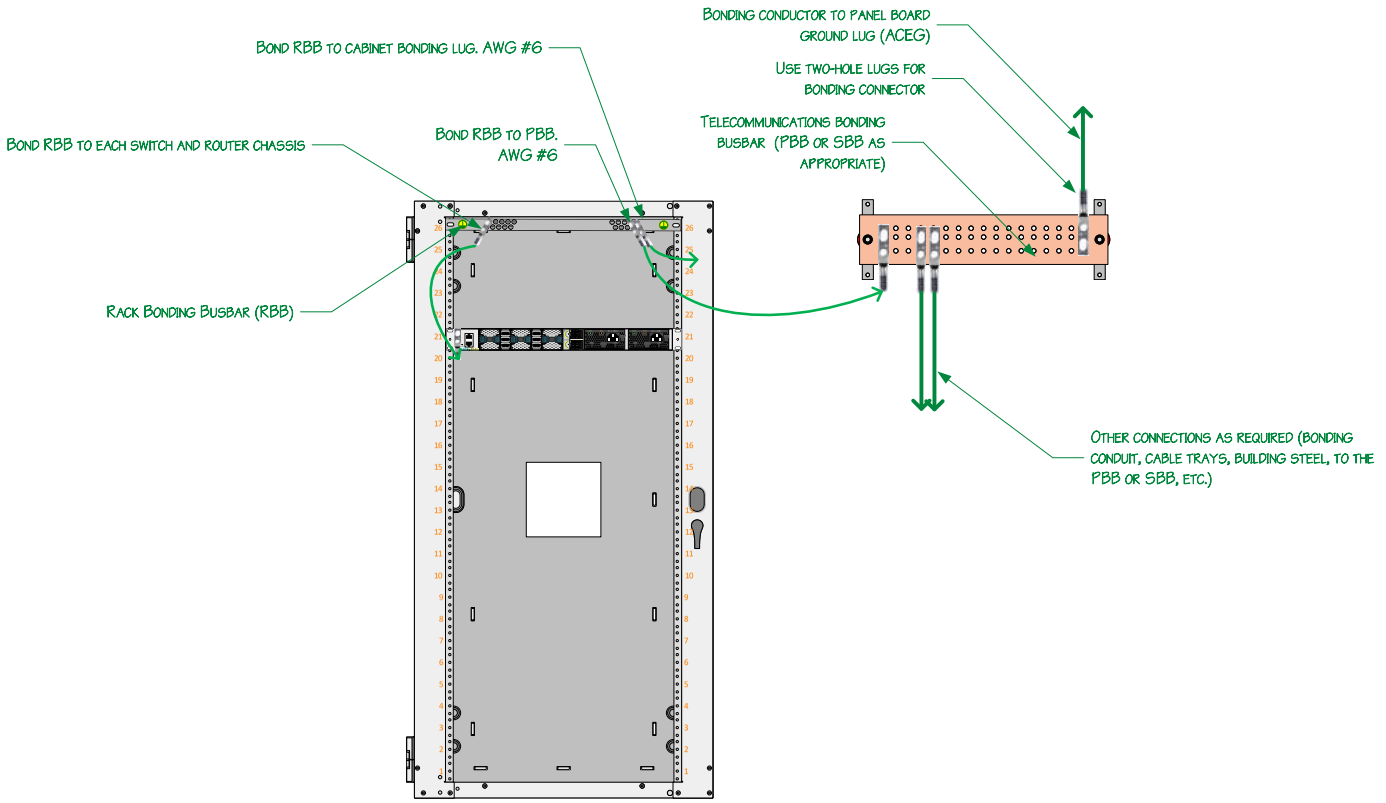
TE 12RU ELEVATION



1 BONDING TOPOLOGY FOR TELECOMMUNICATIONS ENCLOSURES
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TE BONDING

ELECTRICAL DISTRIBUTION AND BONDING

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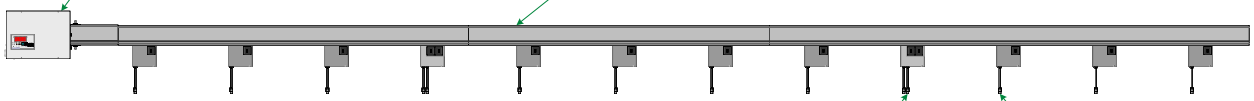
ELECTRICAL DISTRIBUTION AND BONDING



Power feed unit
With current monitor to support each row (30% oversized on amperage). Power calculations to be performed by others.

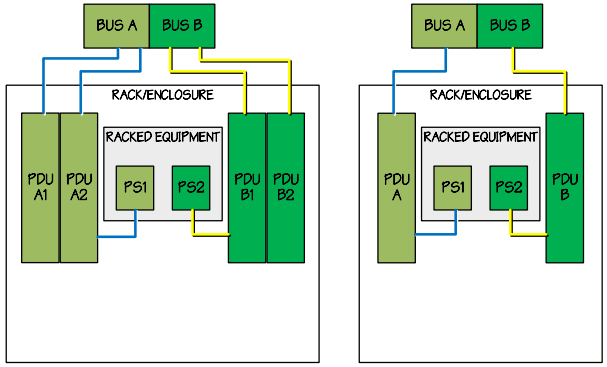
208 V three-phase power bus bar

Power busway tap with dual breaker with two 3 ft drop cords (with strain relief) With L21-20R for high-density cabinets

Power busway tap with single breaker 3 ft drop cord (with strain relief) With L21-20R for standard-density cabinets

2 Typical power busway components for server rows

This design provides diverse power inputs for active equipment by splitting the source power across two busways. Each server cabinet will contain a minimum of two equipment-facing zero U vertical rack PDUs – each will be energized by separate busway tap inputs on disparate busways.



High density – Two L21-20 drops per busway

Standard density – One L21-20 drop per busway

1 Power schematic for power rack- level redundancy

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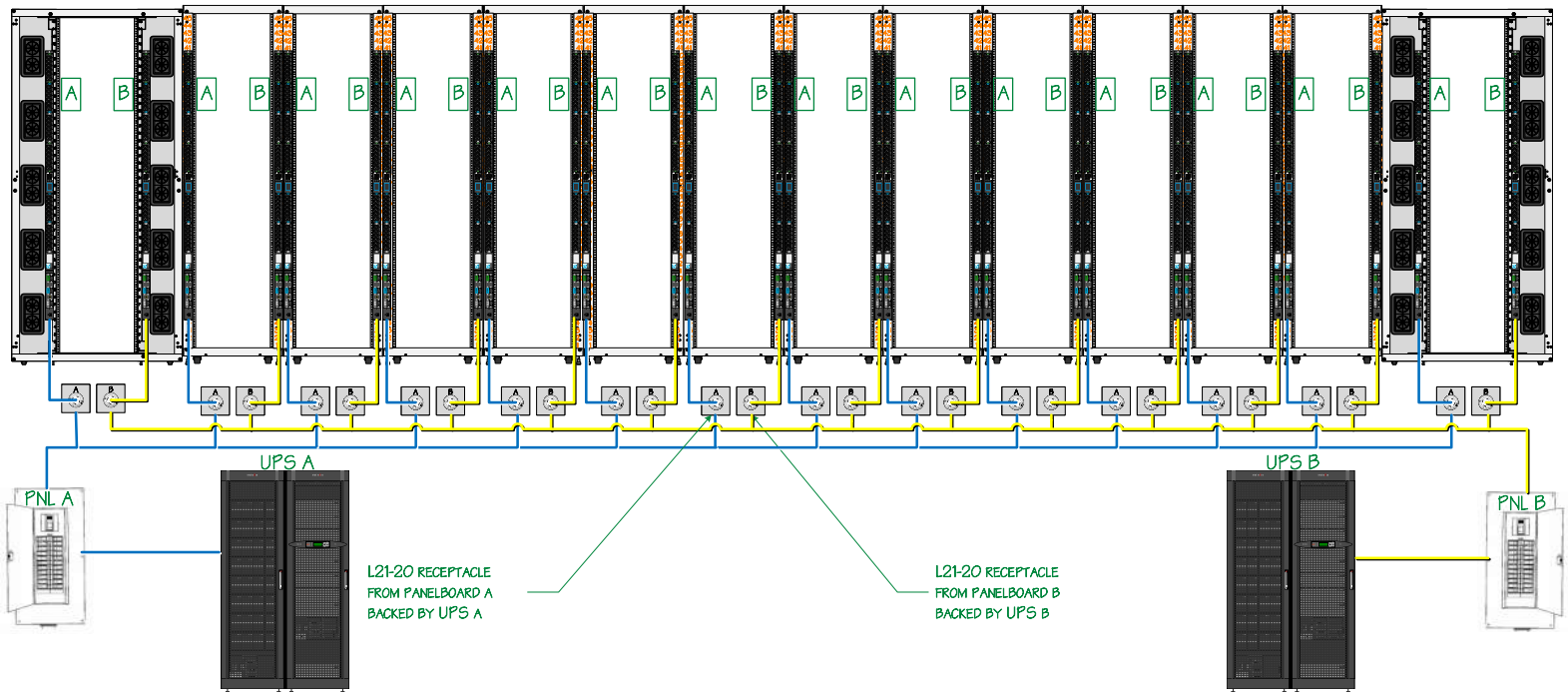
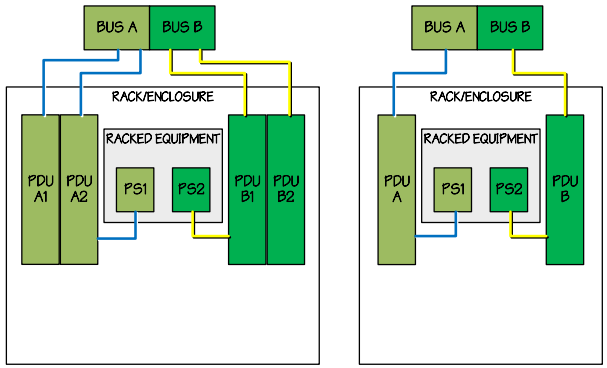
Busway Power Distribution



2 TYPICAL BRANCH CIRCUIT COMPONENTS FOR SERVER ROWS

THIS DESIGN PROVIDES DIVERSE POWER INPUTS FOR ACTIVE EQUIPMENT BY SPLITTING THE SOURCE POWER ACROSS TWO BRANCH CIRCUITS. EACH SERVER CABINET WILL CONTAIN A MINIMUM OF TWO EQUIPMENT-FACING ZERO U VERTICAL RACK PDUs – EACH WILL BE ENERGIZED BY SEPARATE BRANCH CIRCUIT INPUTS ON DISPARATE PANELBOARDS BACKED BY SEPARATE UPS



1 POWER SCHEMATIC FOR POWER RACK- LEVEL REDUNDANCY

DEPARTMENT OF VETERANS AFFAIRS

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INFRASTRUCTURE OPERATIONS - APPLICATION HOSTING, CLOUD AND EDGE SOLUTIONS

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VERIFIED BY: MICHAEL JULIAN, RCDD JOHN WERNAU, KELLY BATES
DOC VERSION No: 4.0
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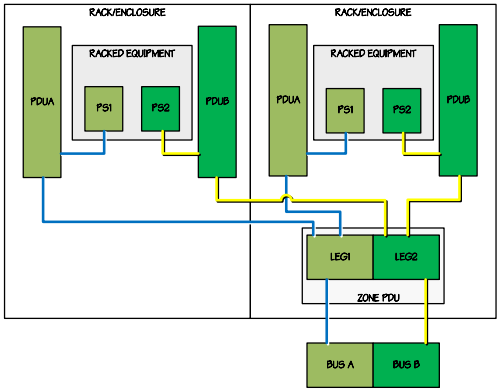
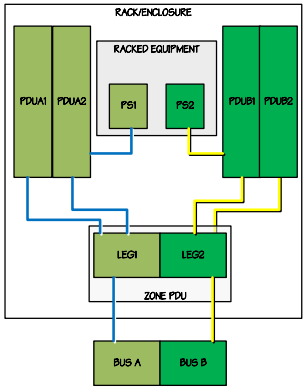
SHEET TITLE
BRANCH CIRCUIT POWER DISTRIBUTION

This design provides diverse power inputs for active equipment by splitting the source power across two zone PDU inputs. Each server cabinet will contain a minimum of two equipment-facing zero U vertical rack PDUs – each will be energized by separate zone PDU inputs.

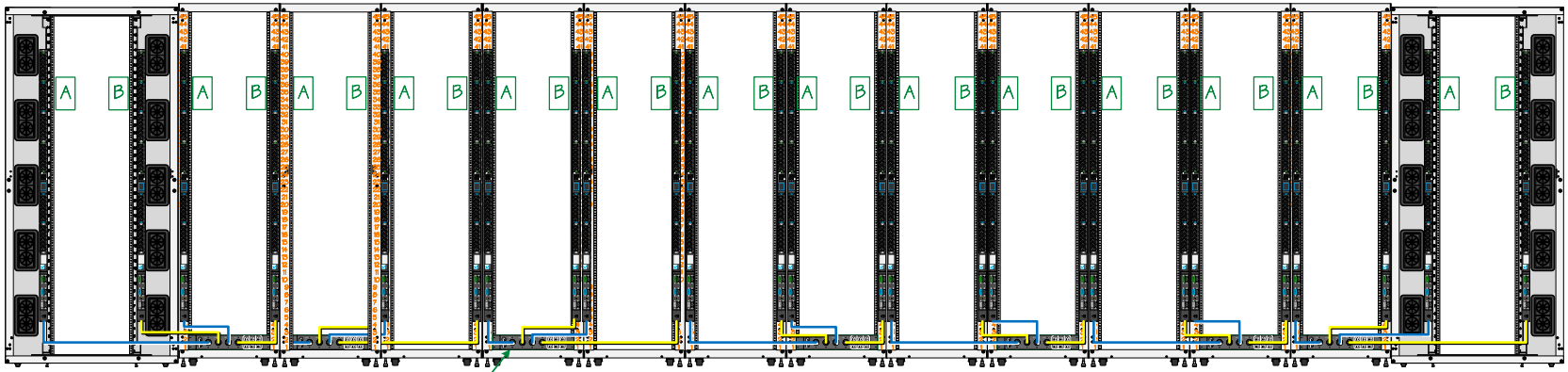


Standard density – One zone PDU per two racks



High density – One zone PDU per rack

② Power schematic for power rack- level redundancy



Seven zone PDUs per server row

Note: MDA rows follow the same schema with one zone PDU per two standard racks/cabinets and one for each high density cabinet.

Note: 30 A zone power distribution is typically used in legacy computer rooms with a raised access floor used for cooling air distribution. Enclosure densities are limited to 3.5 kW (SD) and 7 kW (HD) in these types of environments.

① Subzone to 30A zone PDU connection map for typical (14 rack) server rows

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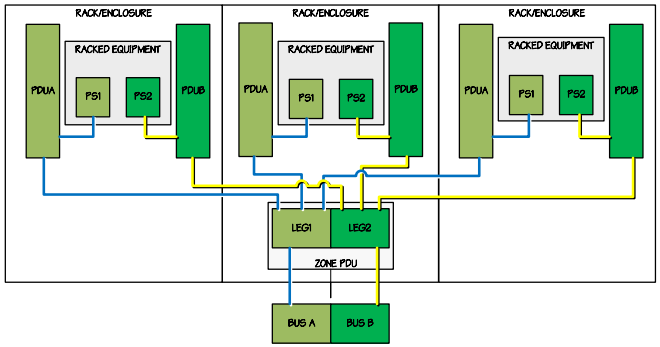
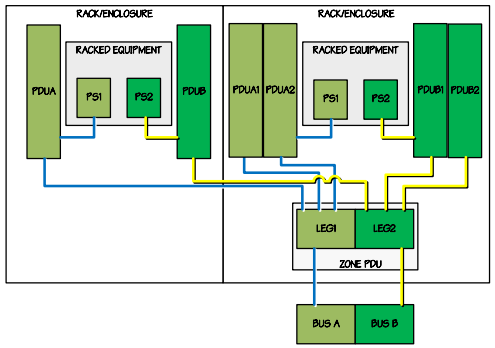
30A Zone PDU Power Distribution



ONE ZONE PDU FOR THREE STANDARD DENSITY SERVER CABINETS/NETWORK RACKS

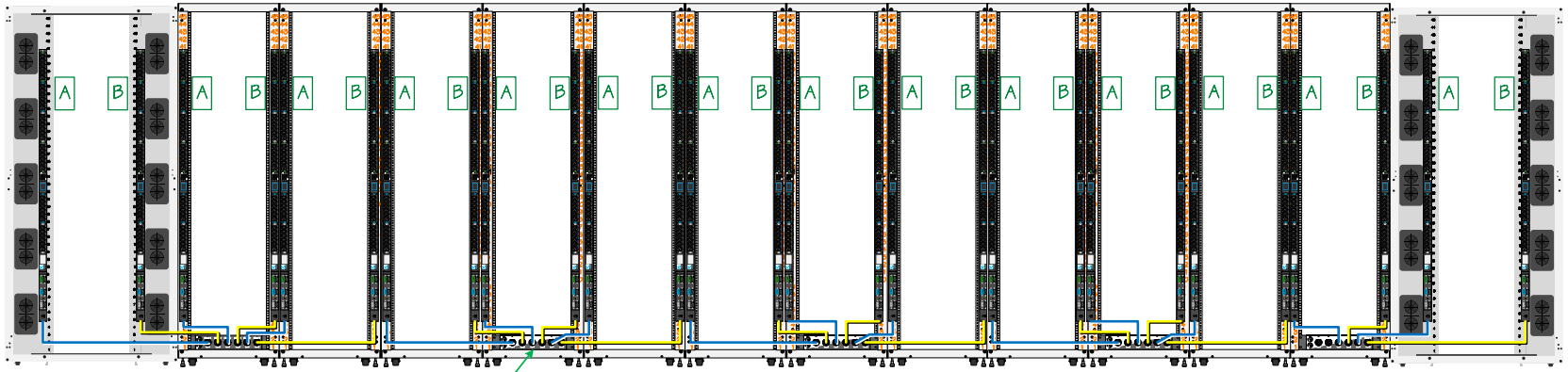


ONE ZONE PDU FOR ONE STANDARD DENSITY SERVER CABINET AND ONE HIGH DENSITY SERVER CABINET

NOTE:

THIS DESIGN PROVIDES DIVERSE POWER INPUTS FOR ACTIVE EQUIPMENT BY SPLITTING THE SOURCE POWER ACROSS TWO INPUTS ON THE ZONE PDU. EACH INPUT WILL SUPPORT THREE EQUIPMENT-FACING RACK PDUs. EACH SERVER CABINET WILL CONTAIN A MINIMUM OF TWO EQUIPMENT-FACING PDUs – EACH WILL BE ENERGIZED BY SEPARATE ZONE PDU INPUTS.

(2) POWER SCHEMATIC FOR POWER RACK- LEVEL REDUNDANCY



FIVE ZONE PDUs PER ROW

NOTE: MDA ROWS FOLLOW THE SAME SCHEMA WITH ONE ZONE PDU PER THREE STANDARD RACKS/CABINETS AND ONE FOR EACH SET OF ONE HIGH DENSITY CABINET AND ONE STANDARD DENSITY CABINET

(1) SUBZONE TO 60A ZONE PDU CONNECTION MAP FOR TYPICAL (14 RACK) SERVER ROWS

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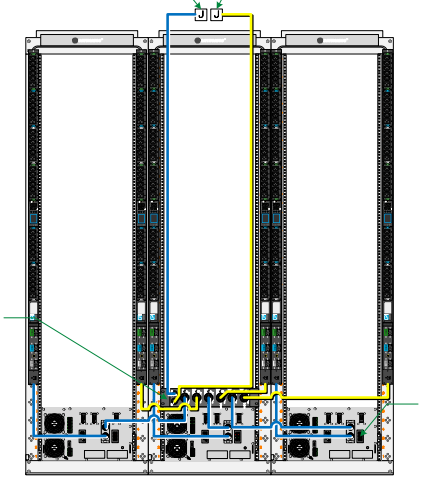
SHEET TITLE

60A ZONE PDU POWER DISTRIBUTION

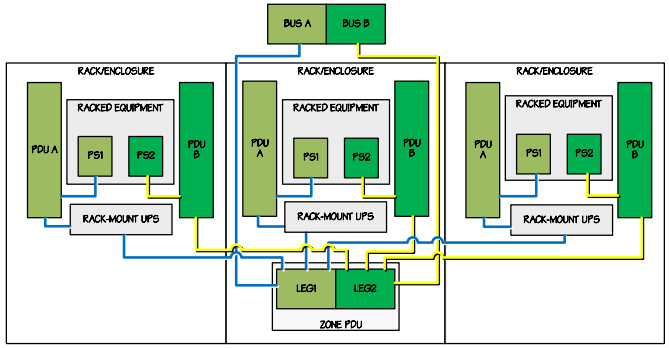
SIDE A
REQUIRES A 208 V, 60 A, THREE-PHASE CIRCUIT, TERMINATING IN A HARD-WIRED JUNCTION BOX

SIDE B
REQUIRES A 208 V, 60 A, THREE-PHASE CIRCUIT, TERMINATING IN A HARD-WIRED JUNCTION BOX

ZONE PDU
60 A 3-PHASE ZONE PDU BASE UNIT – REQUIRES TWO 60 A 3-PHASE (WYE) CIRCUITS HARD-WIRED IN JUNCTION BOX; OPTIONALLY, UPSS AND B-SIDE RPDUS MAY BE POWERED DIRECTLY WITH L21-20 OUTLETS



RACK-MOUNTED 5 kW, 208 V UNINTERRUPTIBLE POWER SUPPLY (UPS) WITH NEMA 20A L21-20P INPUT AND L21-20R OUTPUT

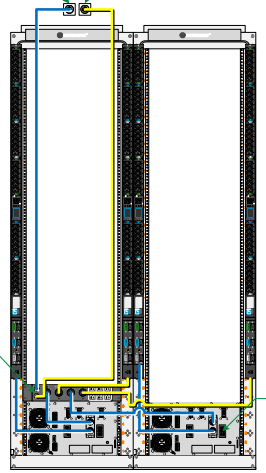


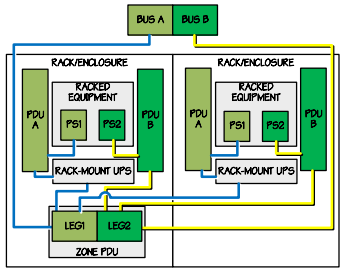
3 POWER ELEVATION AND SCHEMATIC FOR A THREE RACK TR

L21-30P SIDE A
REQUIRES A 208 V, 30 A, THREE-PHASE CIRCUIT, TERMINATING IN A NEMA L21-30R LOCKING RECEPTACLE

L21-30P SIDE B
REQUIRES A 208 V, 30 A, THREE-PHASE CIRCUIT, TERMINATING IN A NEMA L21-30R LOCKING RECEPTACLE

ZONE PDU
30 A THREE-PHASE ZONE PDU BASE UNIT – REQUIRES TWO 30 A THREE-PHASE (WYE) CIRCUITS WITH L21-30R RECEPTACLES; OPTIONALLY, UPSS AND B-SIDE RPDUS MAY BE POWERED DIRECTLY WITH L21-20 OUTLETS



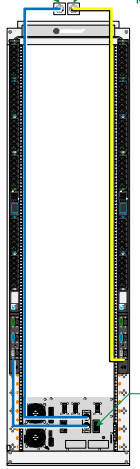


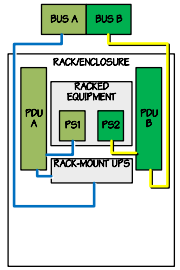
RACK-MOUNTED 5 kW, 208 V UPS WITH NEMA 20 A L21-20P INPUT AND L21-20R OUTPUT

2 POWER ELEVATION AND SCHEMATIC FOR A TWO RACK TR

L21-20P SIDE A
REQUIRES A 208 V, 20 A, THREE-PHASE CIRCUIT, TERMINATING IN A NEMA L21-20R LOCKING RECEPTACLE

L21-20P SIDE B
REQUIRES A 208 V, 20 A, THREE-PHASE CIRCUIT, TERMINATING IN A NEMA L21-20R LOCKING RECEPTACLE





RACK-MOUNTED 5 kW, 208 V UPS WITH NEMA 20A L21-20P INPUT AND L21-20R OUTPUT

1 POWER ELEVATION AND SCHEMATIC FOR A ONE RACK TR

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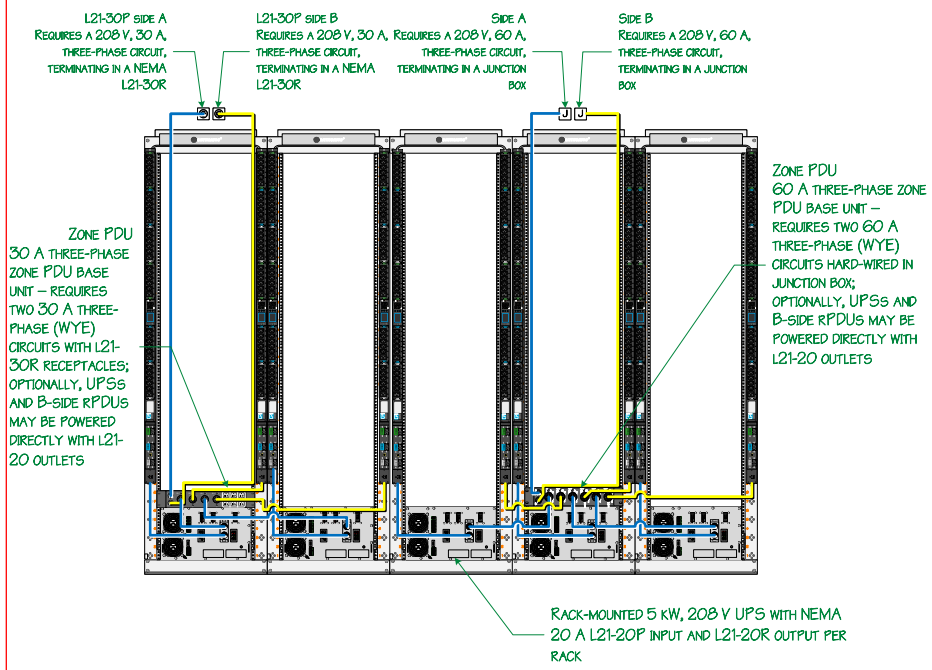
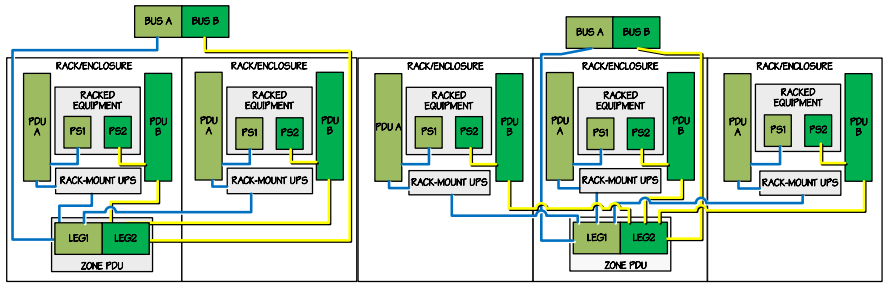
SHEET TITLE
ZONE PDU POWER DISTRIBUTION IN TRS

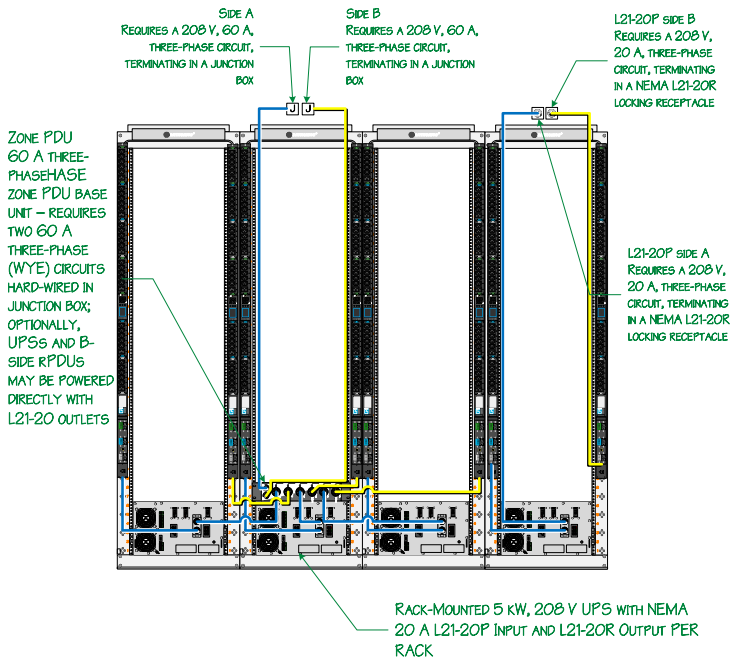


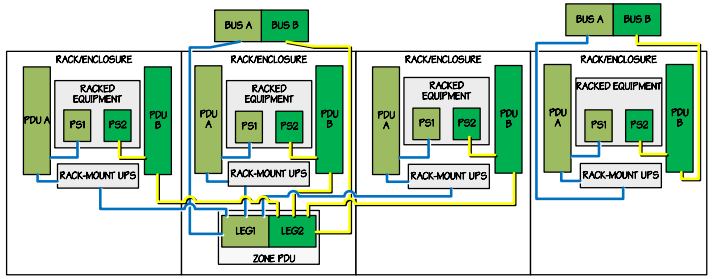


One zone PDU
30 A three-phase zone PDU base unit – requires two 30 A three-phase (WYE) circuits with L21-30R receptacles to support two racks

One zone PDU
60 A three-phase zone PDU base unit – requires two 60 A three-phase (WYE) circuits hard-wired in junction box to support three racks

2 Power elevation and schematic for a five rack TR





One zone PDU
60 A three-phase zone PDU base unit – requires two 60 A three-phase (WYE) circuits hard-wired in junction box to support three racks

Requires two 20 A three-phase (WYE) circuits terminating in L21-20Rs

1 Power elevation and schematic for a four rack TR

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VERIFIED BY: Michael Juluan, RCDD; John Wernau, Kelly Bates
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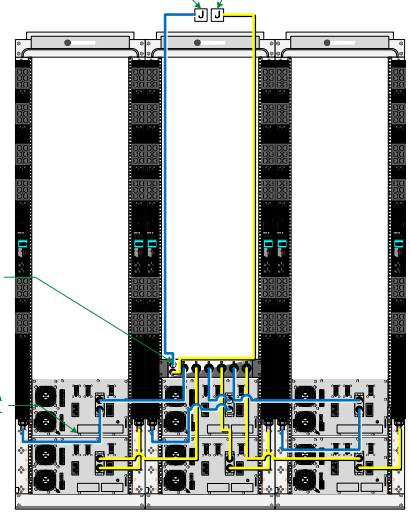
SHEET TITLE
Zone PDU Power Distribution in Four and Five Rack TRs

Side A
Requires a 208 V, 60 A, three-phase circuit, terminating in a hard-wired junction box

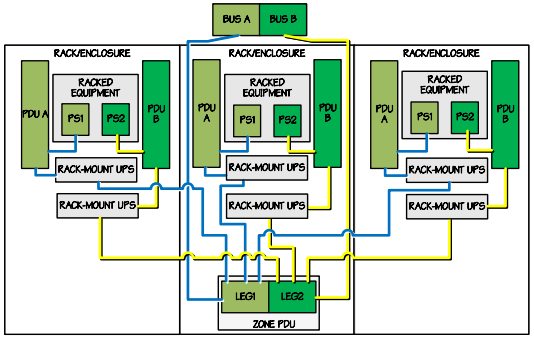
Side B
Requires a 208 V, 60 A, three-phase circuit, terminating in a hard-wired junction box



Zone PDU
60 A three-phase zone PDU base unit – requires two 60 A three-phase (WYE) circuits hard-wired in junction box; optionally, UPSs may be powered directly with L21-20 outlets

Rack-mounted 5 kW, 208 V UPS with NEMA 20 A L21-20P input and L21-20R output

2 POWER ELEVATION FOR A HEALTH CARE FACILITY ENTRANCE ROOM



One zone PDU
60 A three-phase zone PDU base unit – requires two 60 A three-phase (WYE) circuits hard-wired in junction box to support three racks

1 POWER SCHEMATIC FOR A HEALTH CARE FACILITY ENTRANCE ROOM

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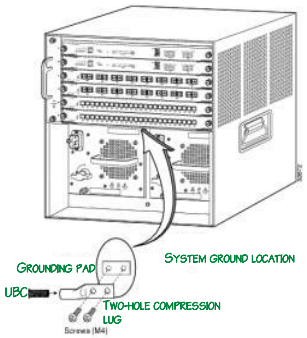
SHEET TITLE
Zone PDU Power Distribution in a Health Care Facility Entrance Room

NOTE: ALL GROUNDING SHALL BE DONE IN ACCORDANCE WITH ANSI/TIA -607-D "COMMERCIAL BUILDING GROUNDING (EARTHING) AND BONDING REQUIREMENTS FOR TELECOMMUNICATIONS", NFPA 70, AND IN COMPLIANCE WITH LOCAL CODES.

ALL EQUIPMENT SHALL BE GROUNDED PER MANUFACTURER'S INSTRUCTIONS.

NETWORK EQUIPMENT MUST BE GROUNDED. NEVER DEFEAT THE GROUND CONDUCTOR OR OPERATE THE EQUIPMENT IN THE ABSENCE OF A SUITABLY INSTALLED GROUND CONDUCTOR. THESE DEVICES WILL BE BONDED TO THE RACK BONDING BUSBAR (RBB) IN THE SAME RACK. EACH DEVICE WILL HAVE A DEDICATED UNIT BONDING CONDUCTOR (UBC). THE UBC WILL NOT BE SHARED.

CISCO 6509



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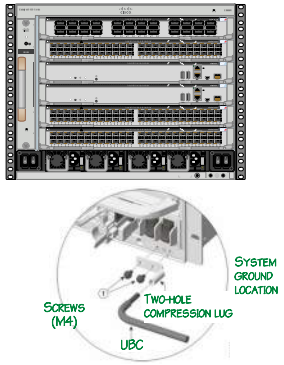
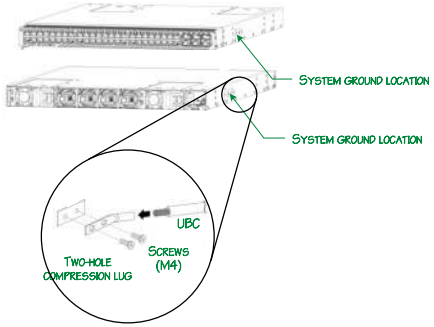
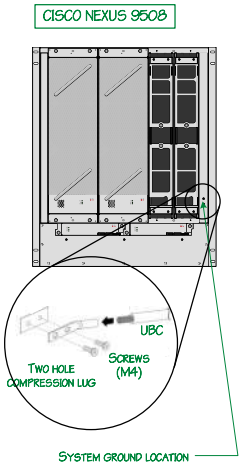


CISCO NEXUS 95108/95180

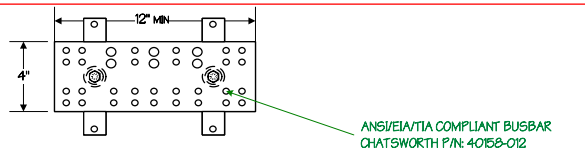


CISCO NEXUS 9508

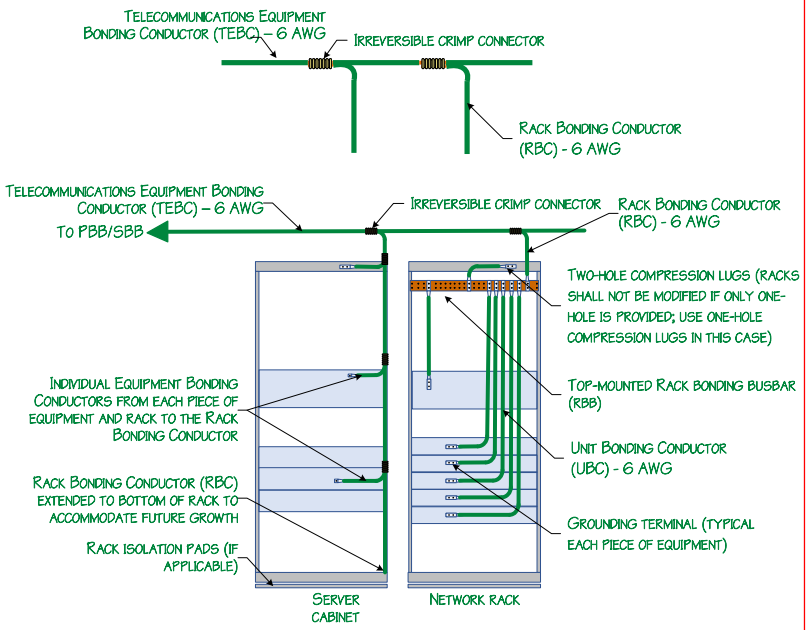


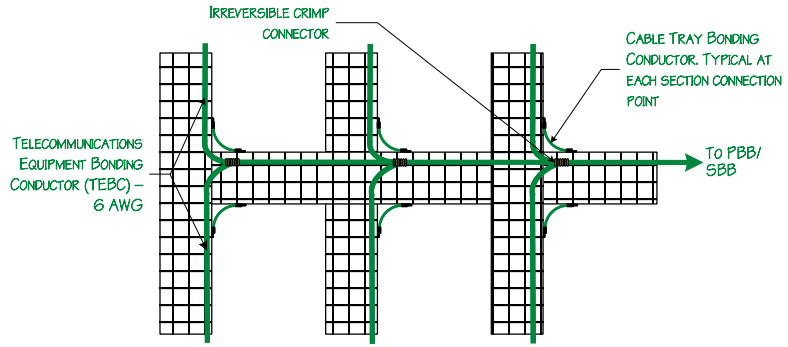
PER MANUFACTURER'S INSTRUCTIONS, WHEN ATTACHING A GROUNDING CABLE TO THE CHASSIS, YOU WILL NEED TO BEND ONE OF THE RACK-MOUNT RAILS SLIGHTLY TO ALLOW THE GROUNDING LUG TO GO BEHIND THE RAIL. ONLY ONE SIDE OF THE CHASSIS NEEDS TO BE BONDED.

2 EARTHING EXAMPLES
REF: CISCO PRODUCT INSTALLATION GUIDE



3 TELECOMMUNICATIONS SECONDARY BONDING BUSBAR (SBB)





1 PATHWAY, RACK, BONDING CONDUCTOR JOIN REQUIREMENTS

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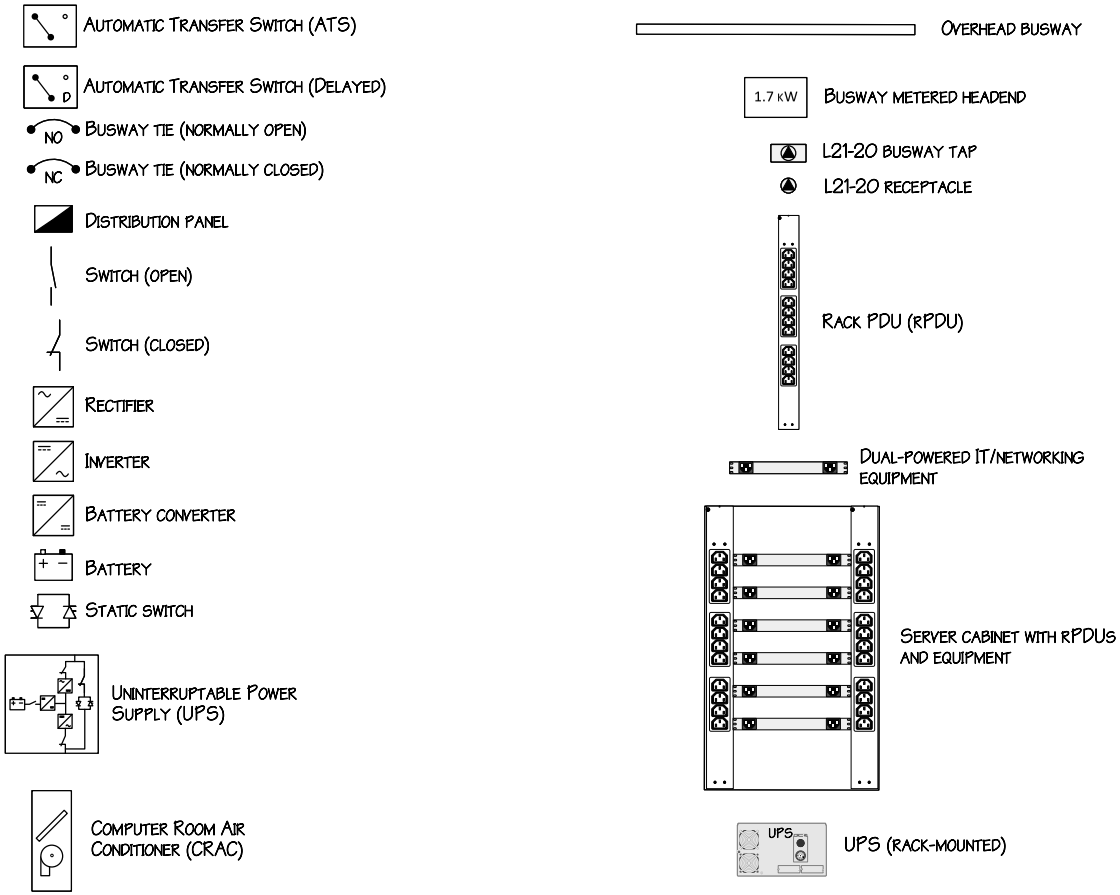

1 LEGEND FOR ELECTRICAL ONE-LINE DRAWINGS

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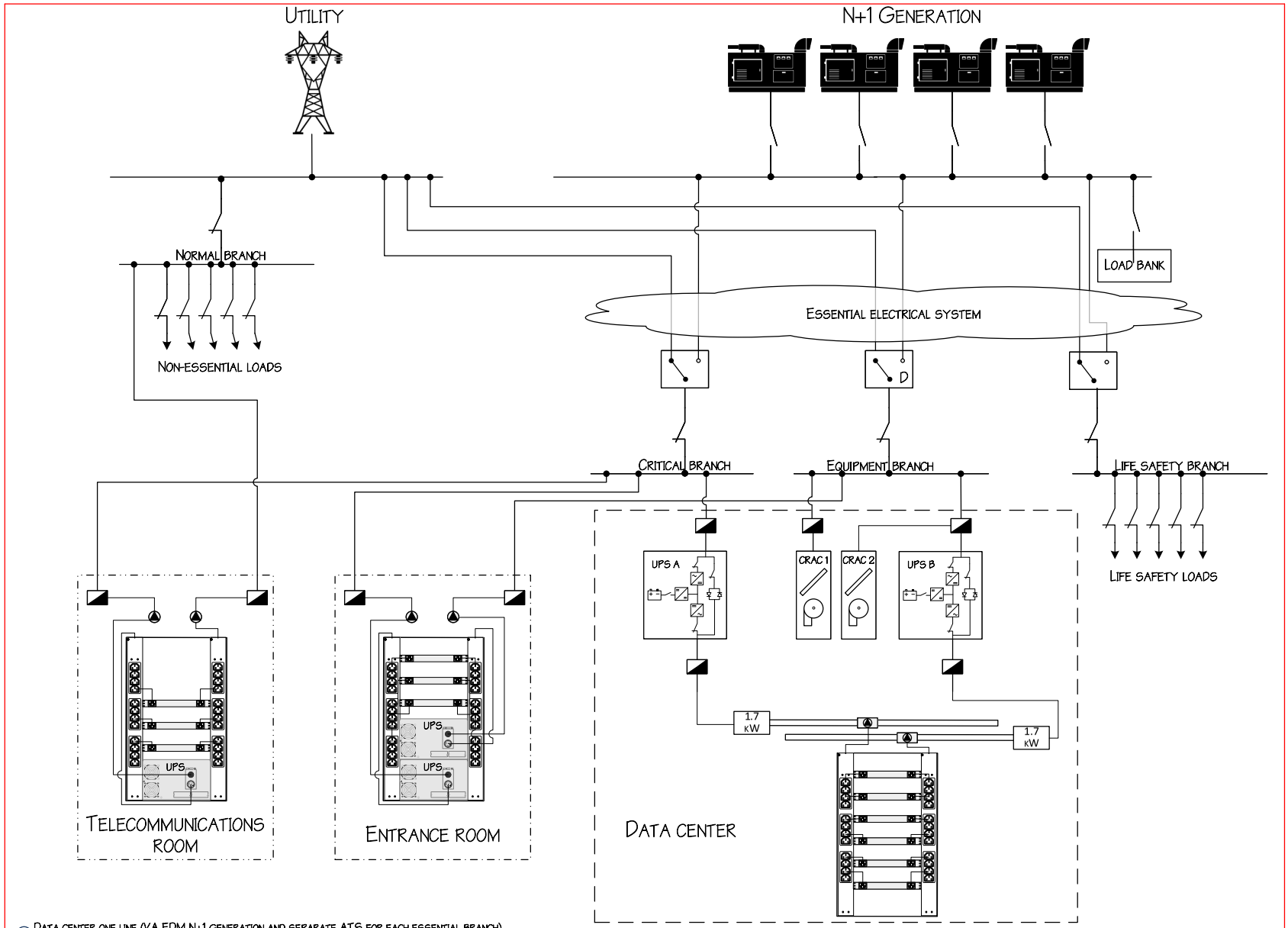
LEGEND FOR ELECTRICAL ONE-LINE DRAWINGS

SHEET: 27 OF 57



1 DATA CENTER ONE LINE (VA EDM N+1 GENERATION AND SEPARATE ATS FOR EACH ESSENTIAL BRANCH)
NOT FOR CONSTRUCTION

DEPARTMENT OF VETERANS AFFAIRS

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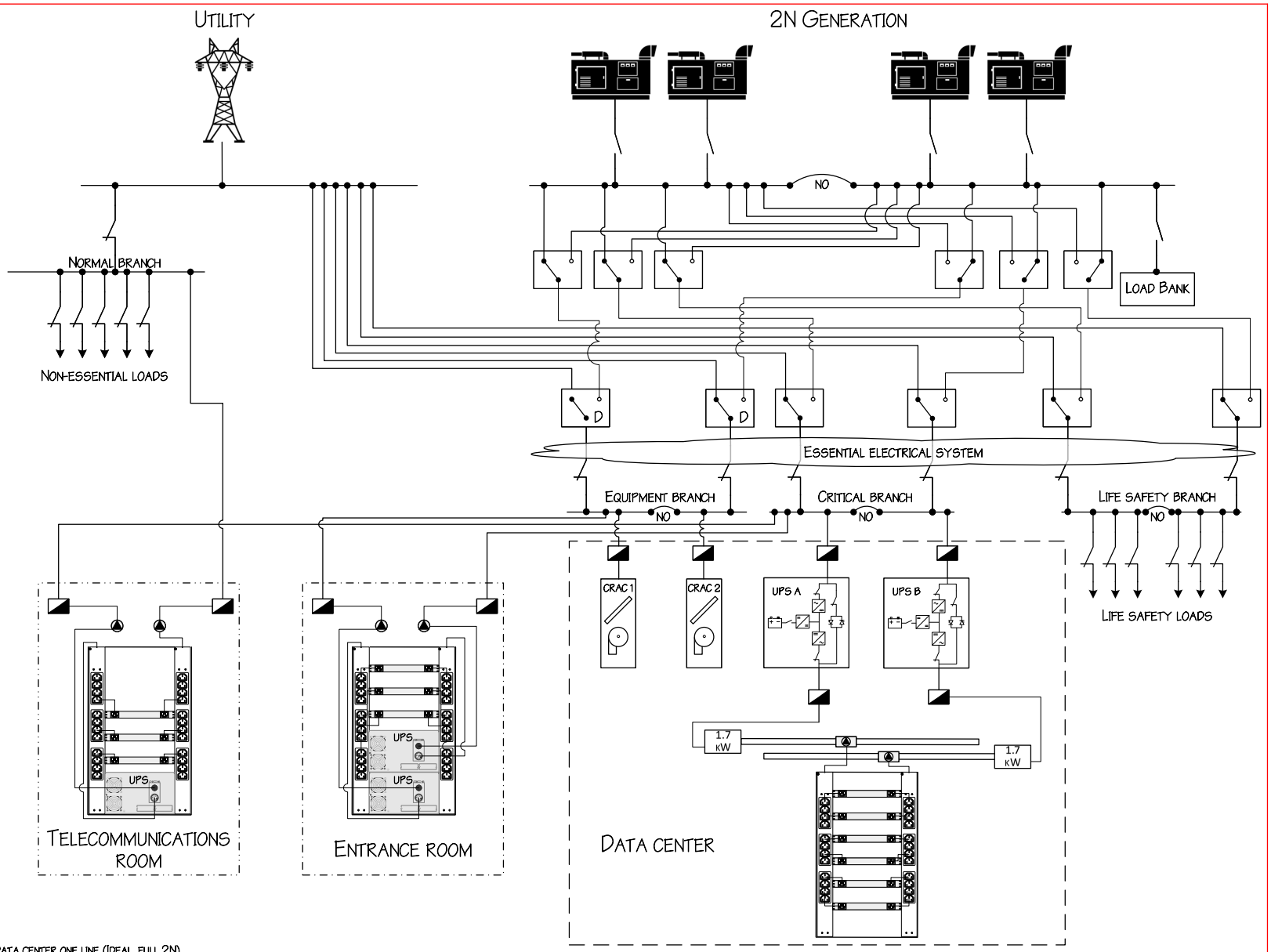
SHEET TITLE
ELECTRICAL ONE-LINE (MINIMUM VA REQUIREMENT)

SHEET: 28 OF 57



1 DATA CENTER ONE LINE (IDEAL, FULL 2N)
NOT FOR CONSTRUCTION

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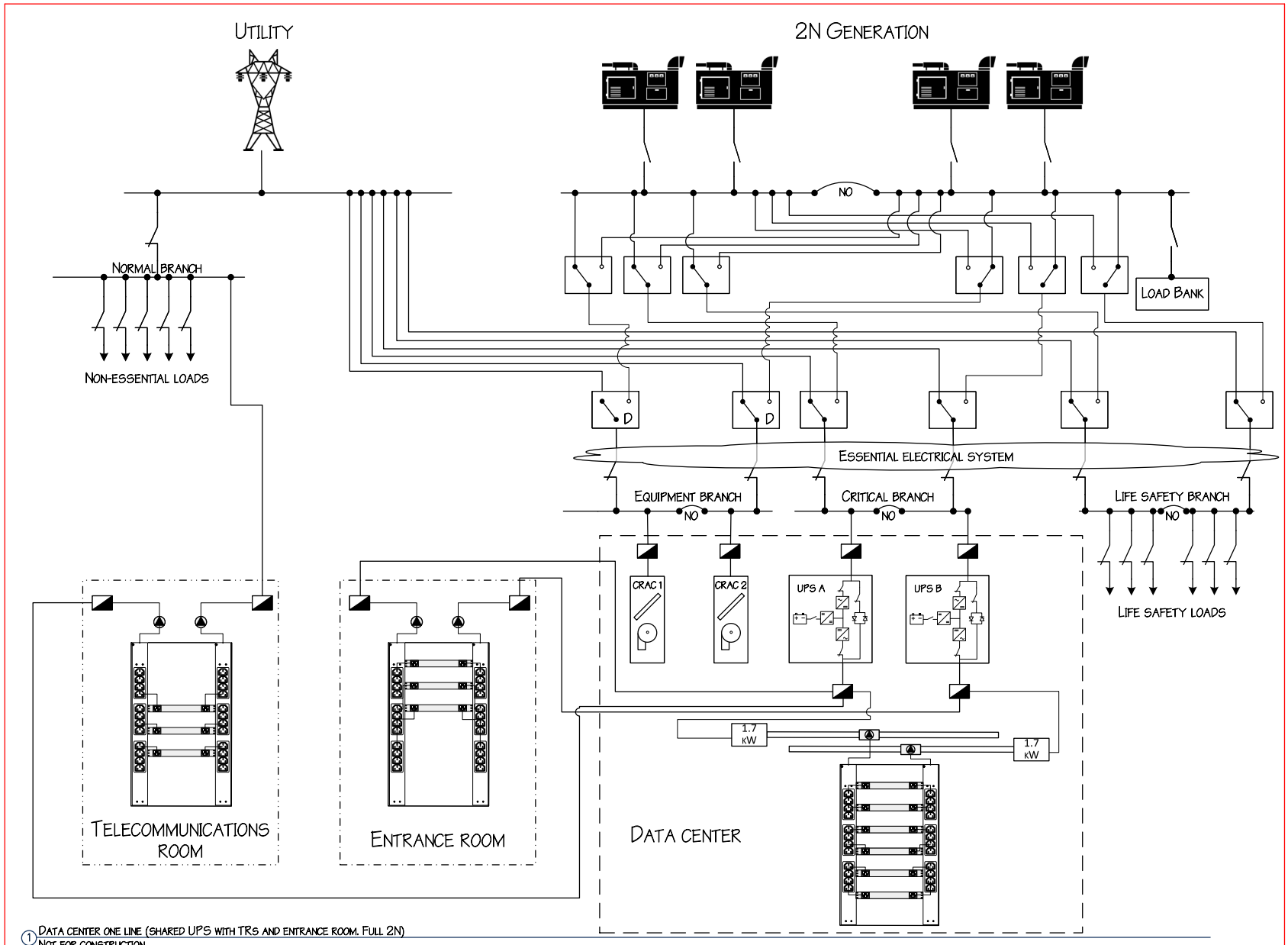
ELECTRICAL ONE-LINE (IDEAL REDUNDANCY)



1 DATA CENTER ONE LINE (SHARED UPS WITH TRS AND ENTRANCE ROOM. FULL 2N)
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SHEET TITLE
ELECTRICAL ONE-LINE (SHARED UPS)

SHEET: 30 OF 57

TELECOMMUNICATIONS DISTRIBUTION (ELEVATIONS, CABLING, AND ROUTING)

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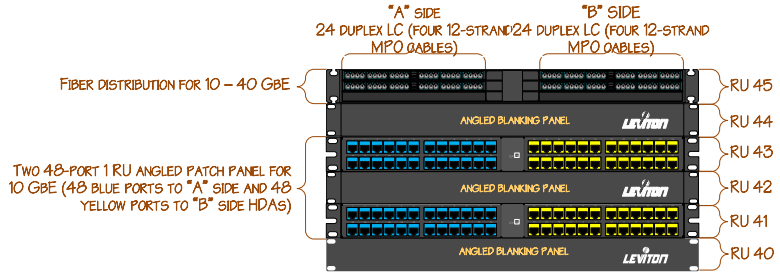
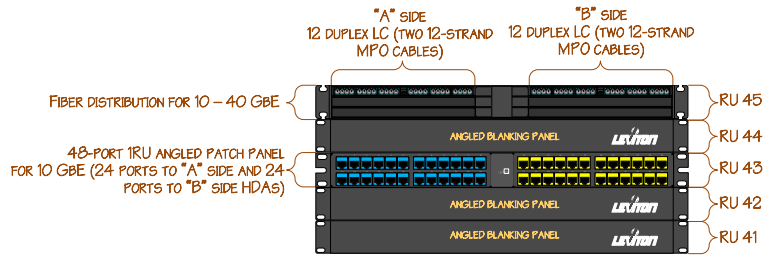
TELECOMMUNICATIONS DISTRIBUTION (ELEVATIONS, CABLING, AND ROUTING)

DATA CENTER SERVER CABINETS (REAR TOP 5 RU OF EACH CABINET)

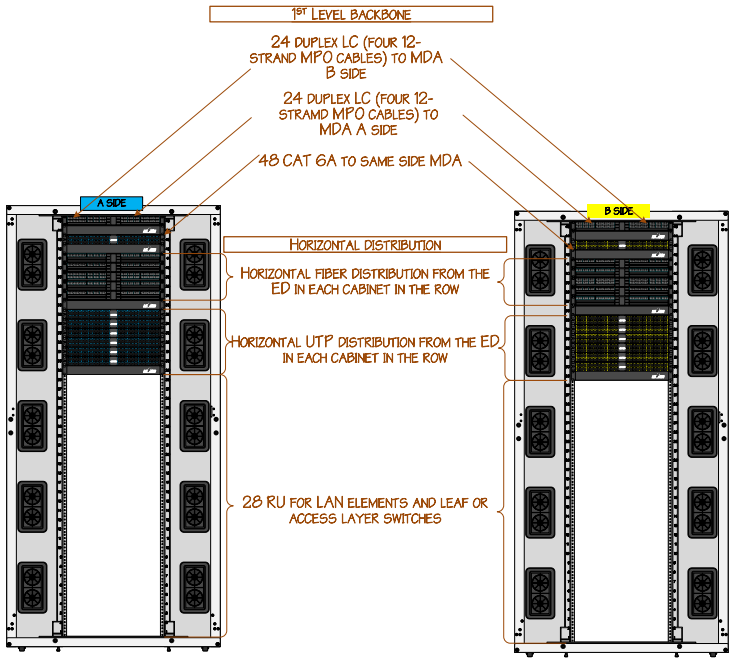


3 HIGH DENSITY EQUIPMENT DISTRIBUTOR ELEVATION FOR CABINETS



2 STANDARD DENSITY EQUIPMENT DISTRIBUTOR ELEVATION FOR CABINETS

DATA CENTER NETWORK CABINETS (END OF EACH ROW: A-SIDE ONE END, B-SIDE ON THE OTHER END)



1 TYPICAL END OF ROW HORIZONTAL DISTRIBUTION AREA

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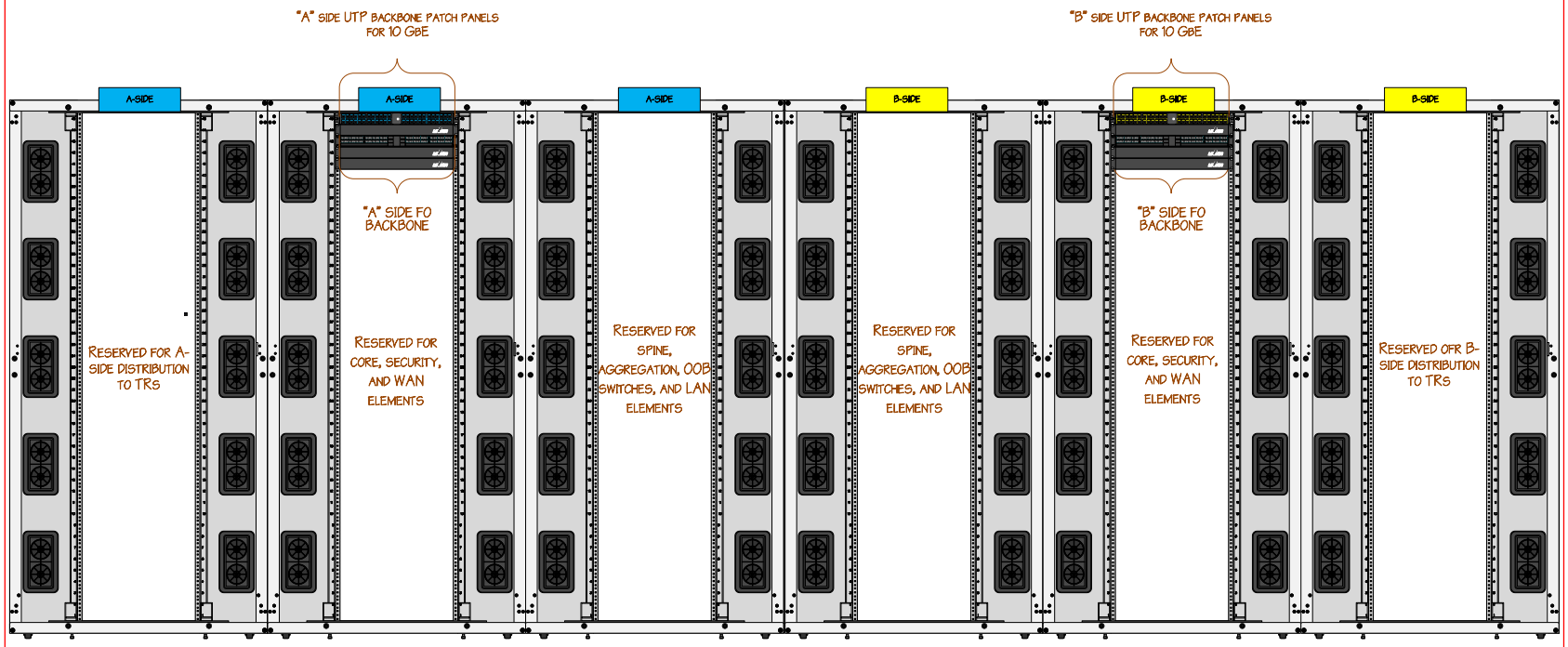
ED & HD (L, M, S)

NETWORK CABINETS CREATING ONE ROW IN THE DATA CENTER ESTABLISHING THE MAIN DISTRIBUTION AREA



1 SMALL DATA CENTER MAIN DISTRIBUTION AREA (A & B SIDES)

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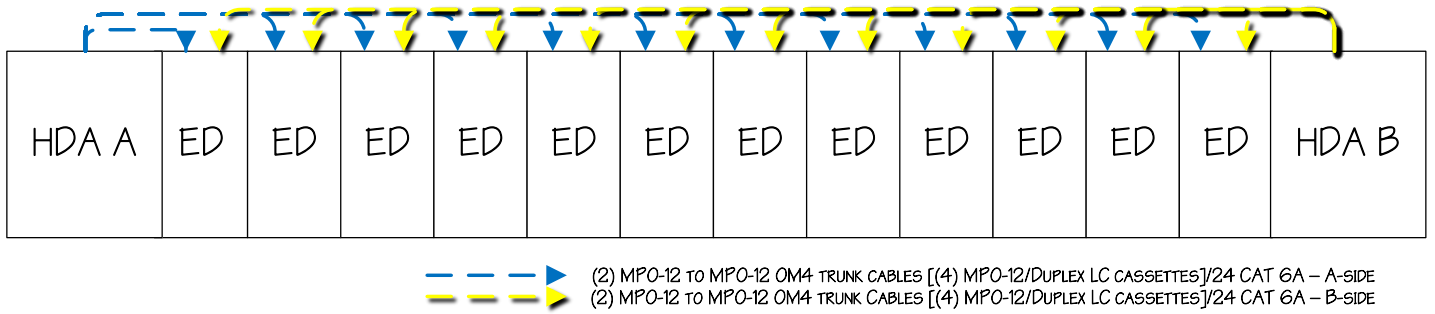
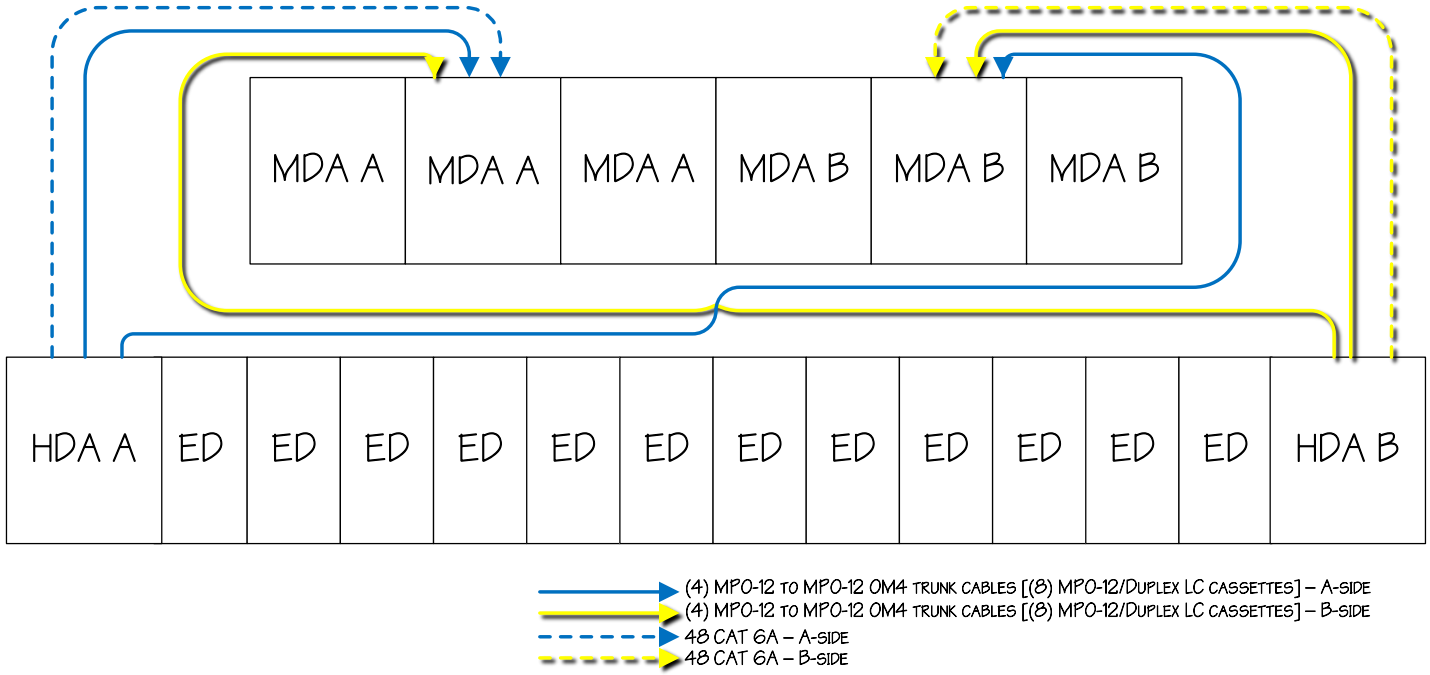
MDA (S)

Data center diverse path distribution



② Diverse routing cabinets (equipment distributor) to horizontal distribution area



① Diverse routing horizontal distribution area to main distribution area

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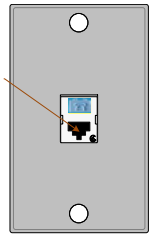
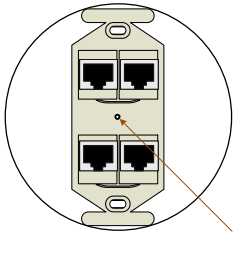
Small Data Center (MCR) Network Diversity



4 TYPICAL WALL MOUNT PHONE VOIP OUTLET



5 TYPICAL WORK FLOOR MOUNT OUTLET

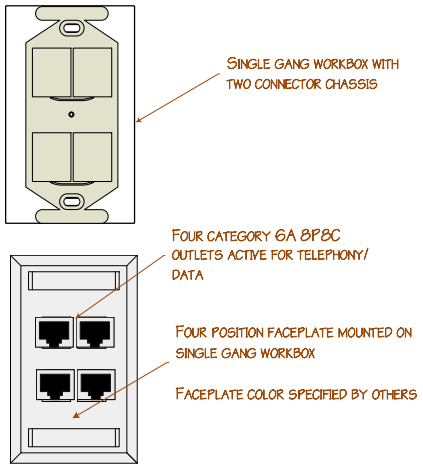
Note:

TYPICAL WORK AREA OUTLET FACEPLATE WILL BE INSTALLED WITH CATEGORY 6A COMPONENT-COMPLIANT 8P8C MEDIA INTERFACE CONNECTORS (RJ45). EACH CONNECTOR WILL BE TERMINATED TO HIGH QUALITY CATEGORY 6A HORIZONTAL CABLING WHICH WILL TERMINATE IN THE TELECOMMUNICATIONS ROOM AS SPECIFIED ELSEWHERE IN THIS DESIGN PACKAGE.
ALL HORIZONTAL UTP SHALL BE CATEGORY 6A AND TERMINATED TO T568B.

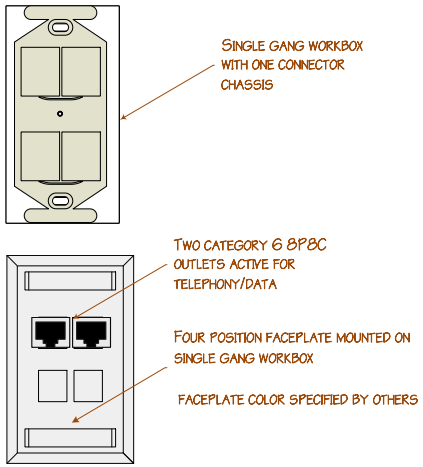
TYPICAL FACEPLATE WILL BE INSTALLED WITH TWO RJ45S. HIGH DENSITY FACEPLATES WILL BE INSTALLED WITH FOUR RJ45S.

FACEPLATE MATERIAL AND COLOR DETERMINED BY OTHERS.

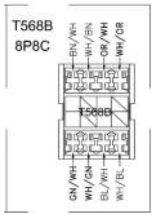
ALL LABELING SHALL BE ANSI/TIA-606-D COMPLIANT AS MODIFIED FOR SOME ELEMENTS IN SECTION 5 OF THE ISTS. MACHINE PRINTED. FURTHER GUIDANCE ON ADMINISTRATION MAY BE SPECIFIED IN OTHER SECTIONS OF THIS DESIGN PACKAGE.



3 TYPICAL HIGH DENSITY WALL MOUNTED WORK AREA OUTLET CONFIGURATION



2 STANDARD DENSITY WALL MOUNTED WORK AREA OUTLET CONFIGURATION



1 ANSI/TIA T568B 8P8C WIRING STANDARD

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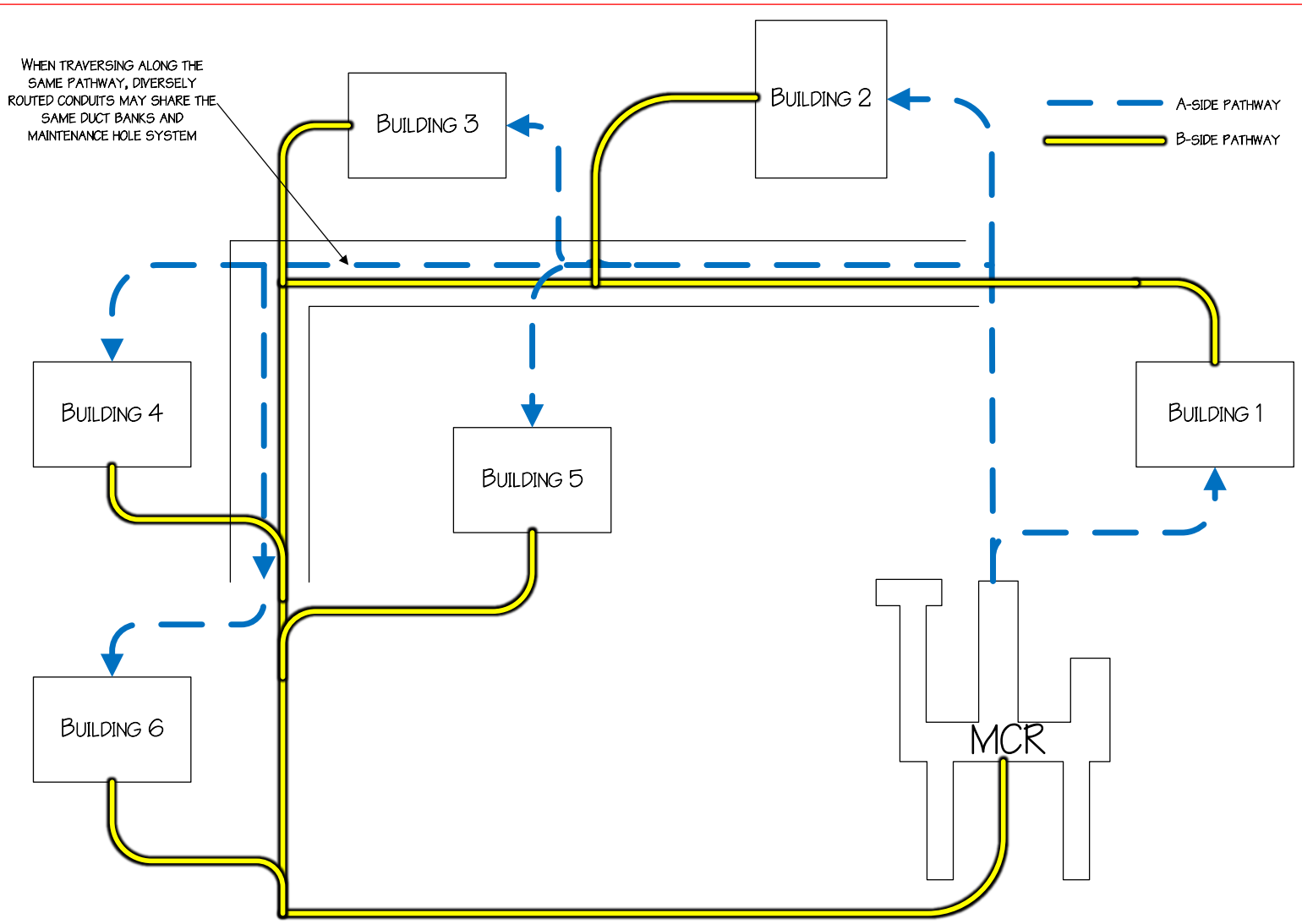
SHEET TITLE
WORK AREA OUTLETS



1 SIMPLIFIED OUTSIDE PLANT DIVERSE TELECOMMUNICATIONS BACKBONE PATHWAYS

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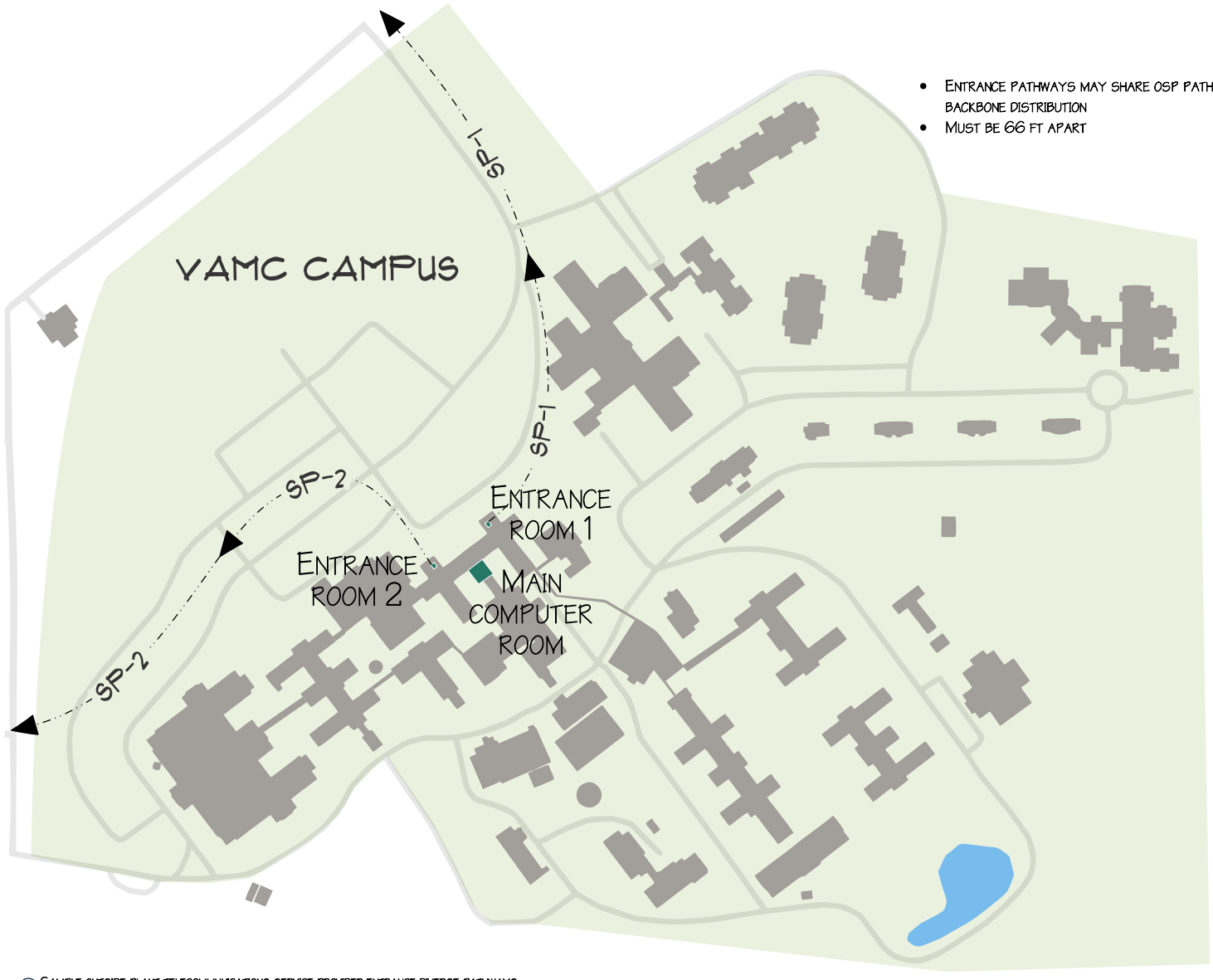
SIMPLIFIED OSP DIVERSE ROUTING



- ENTRANCE PATHWAYS MAY SHARE OSP PATHWAYS WITH BACKBONE DISTRIBUTION
- MUST BE 66 FT APART

1 SAMPLE OUTSIDE PLANT TELECOMMUNICATIONS SERVICE PROVIDER ENTRANCE DIVERSE PATHWAYS

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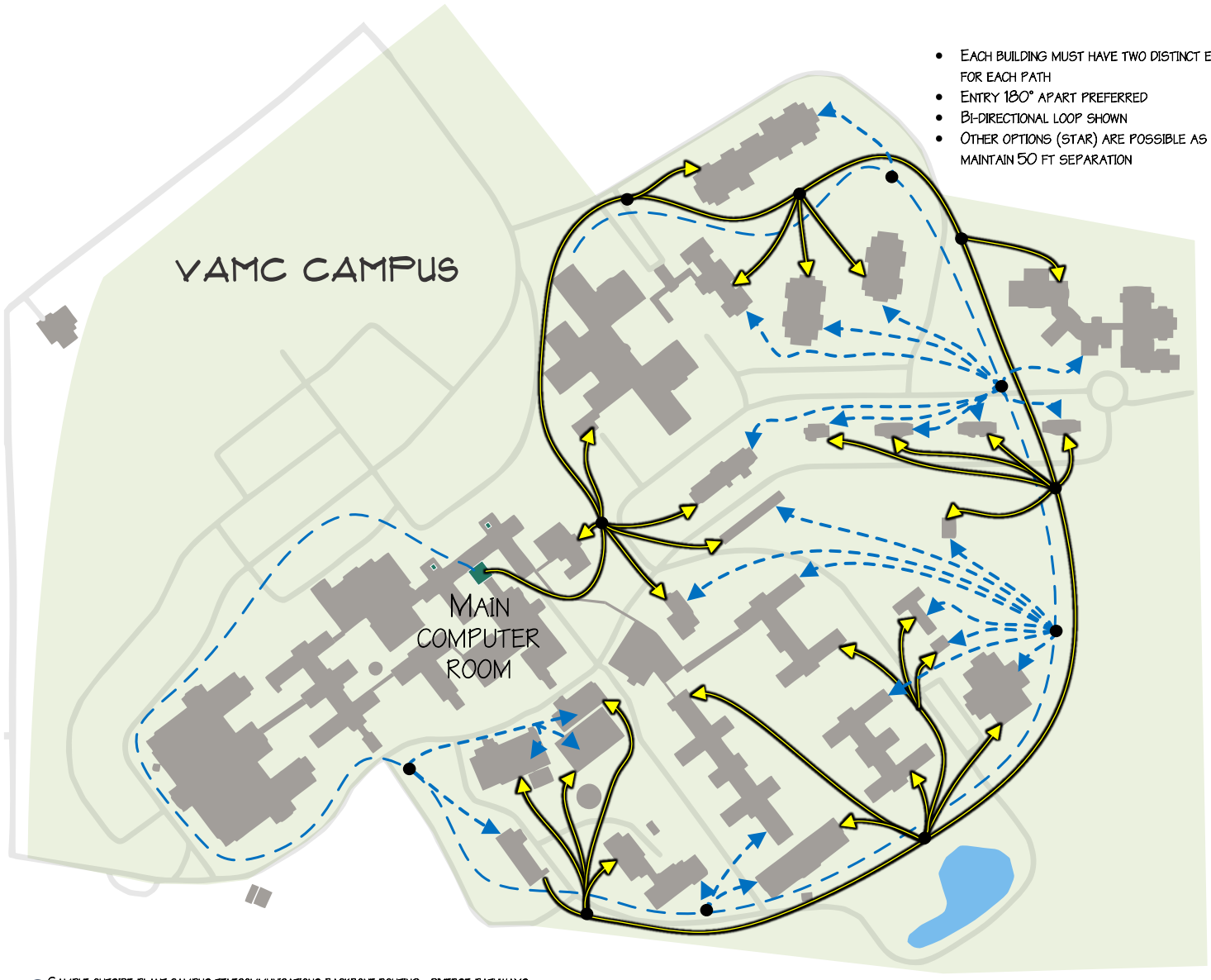
SERVICE PROVIDER PATHWAY ROUTING EXAMPLE

- Each building must have two distinct entry points, one for each path
- Entry 180° apart preferred
- Bi-directional loop shown
- Other options (star) are possible as long as paths maintain 50 ft separation



1 Sample outside plant campus telecommunications backbone routing - diverse pathways

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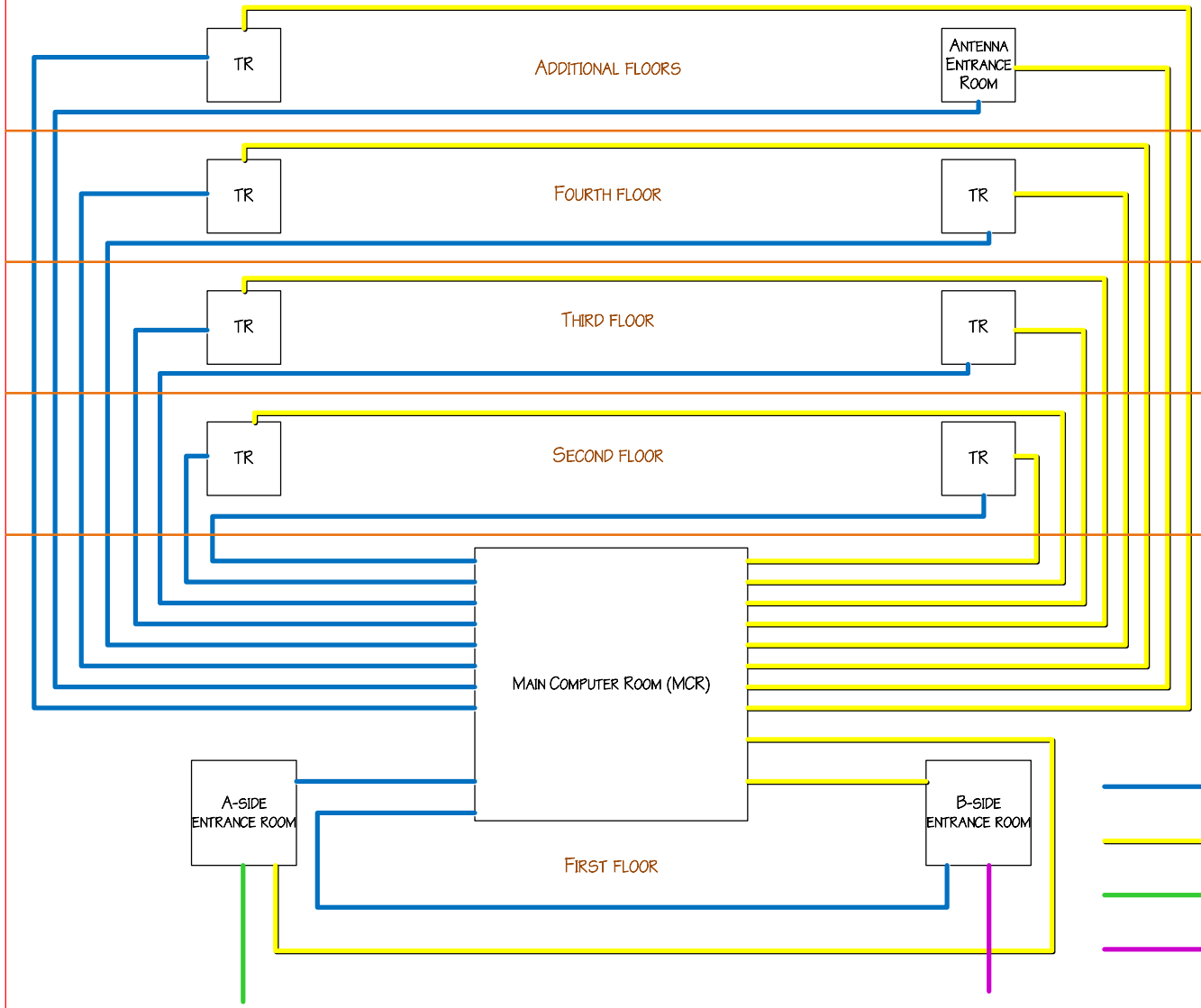
Campus Backbone Pathway Routing Example



NOTE:

- DIAGRAM DEPICTS TYPICAL REDUNDANT AND DIVERSE CABLE ROUTING
- ADDITIONAL TRS PER FLOOR FOLLOW THE SAME DIVERSE ROUTING SCHEMA

A-SIDE BACKBONE (24 STRAND OM4 & 12 STRAMD SM)

B-SIDE BACKBONE (24 STRAND OM4 & 12 STRAND SM)

A-SIDE SERVICE PROVIDER ENTRANCE CABLES

B-SIDE SERVICE PROVIDER ENTRANCE CABLES

1 BACKBONE CABLE ROUTING (REDUNDANT AND DIVERSE)

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SIMPLIFIED INSIDE PLANT BACKBONE PATHWAY ROUTING

SINCE ONLY A SINGLE PATHWAY EXISTS TO THE SW PORTION OF THE BUILDING CLUSTER, THE PATHWAYS FOR A AND B ROUTING WILL NEED TO MAINTAIN DIVERSITY BY ROUTING ON DIFFERENT FLOORS. (E.G. "A" PATHWAY ON FIRST FLOOR, "B" PATHWAY ON THIRD FLOOR. IF ONLY A SINGLE FLOOR INDOOR PATHWAY EXISTS, MINIMALLY SEPARATE PATHWAYS TO OPPOSITE SIDES OF THE HALLWAY)

B-PATHWAY THROUGH OUTSIDE PLANT ROUTING TO AVOID ROUTING ADJACENT TO THE "A" PATHWAY

1 SAMPLE INSIDE PLANT DIVERSE TELECOMMUNICATIONS BACKBONE PATHWAYS

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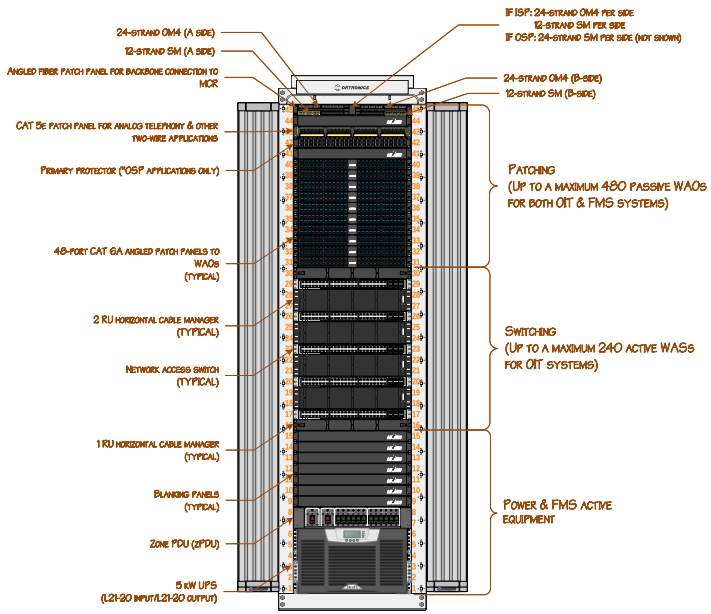
INSIDE PLANT BACKBONE PATHWAY ROUTING EXAMPLE

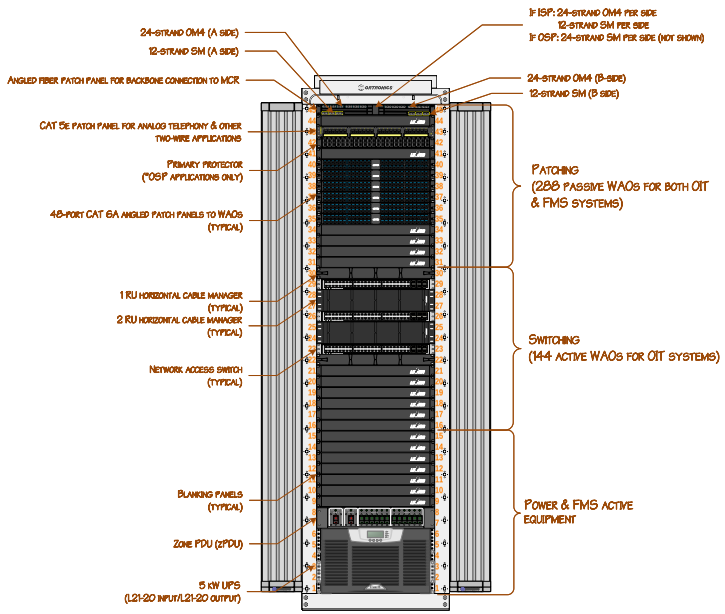
Rule of thirds for TR racks

- Individual rack capacities remain the same regardless of the number of racks in the TR
- Healthcare TR sizing remains 170 ft² except during remodels where the minimum is 100 ft²

TR sizing (non-healthcare)		
1 rack	1-144 WAOs	80 ft²
2 racks	145-240 WAOs	100 ft²
3 racks	241-480 WAOs	120 ft²
4 racks	>480 WAOs	140 ft²



2 Ultimate future capacity – telecommunication room racks



1 Initial planning capacity – telecommunication room racks

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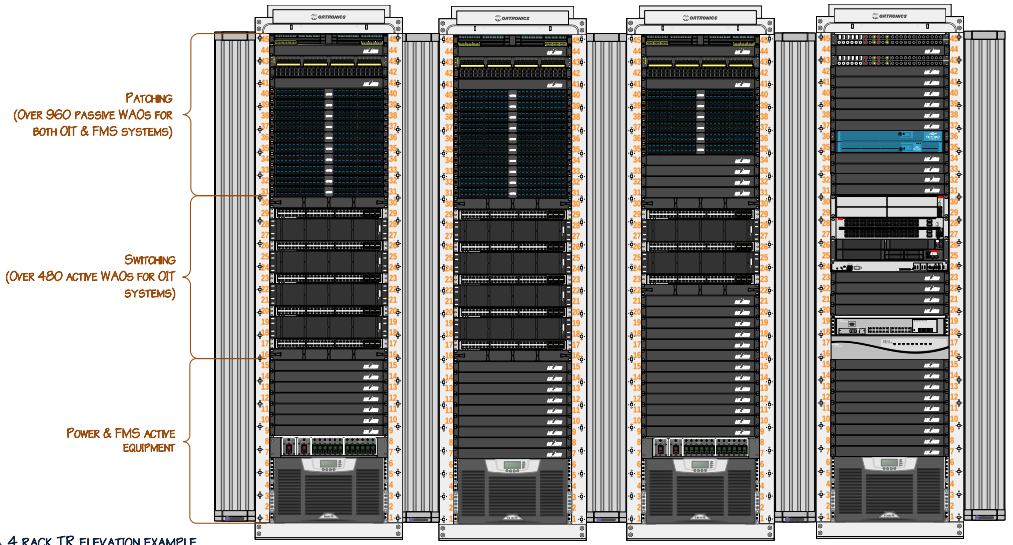
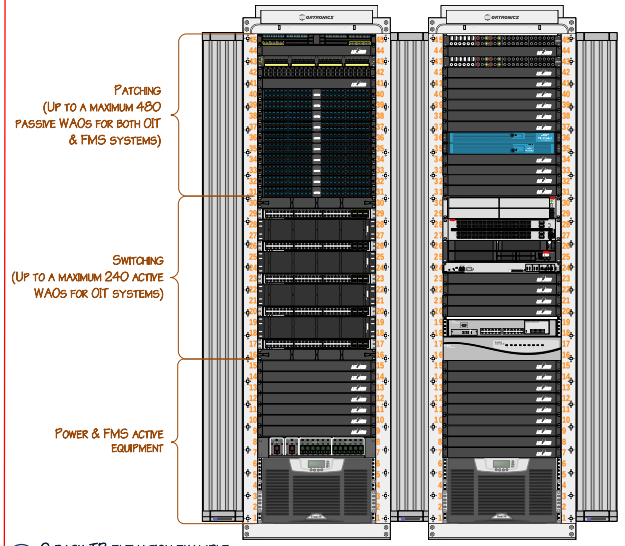
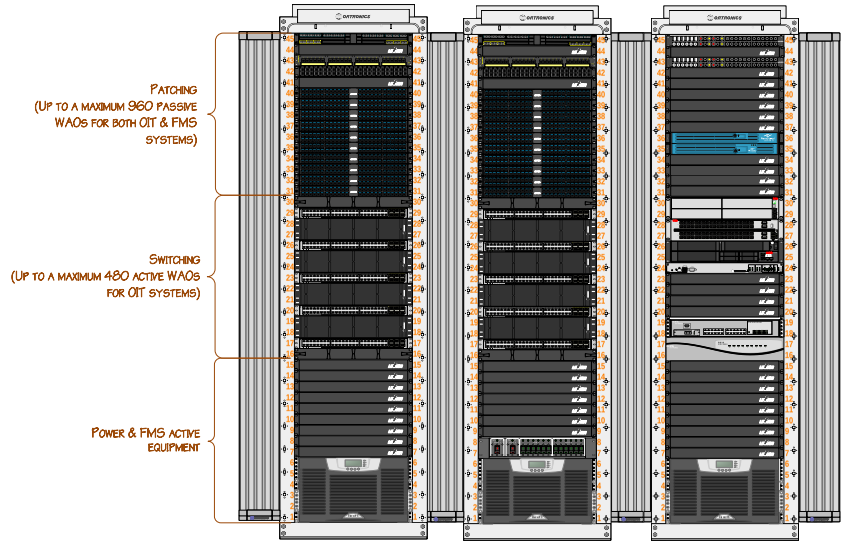


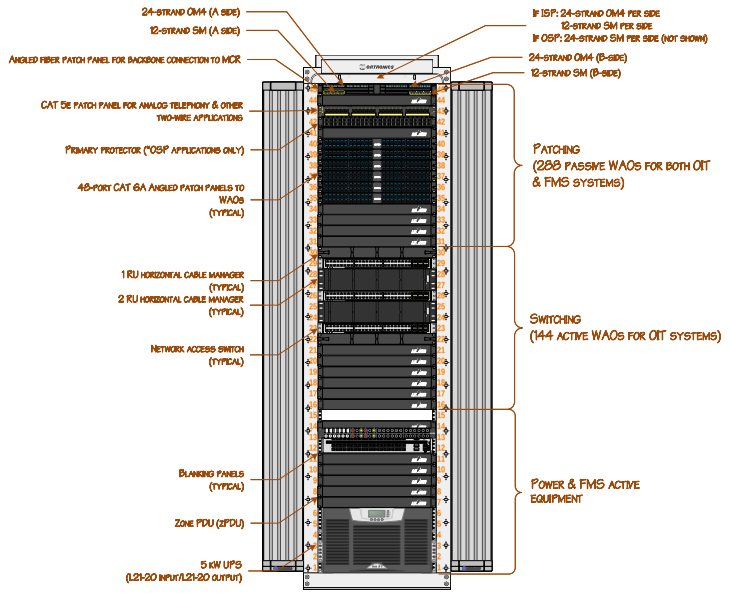
3 4 RACK TR ELEVATION EXAMPLE



4 2 RACK TR ELEVATION EXAMPLE



2 3 RACK TR ELEVATION EXAMPLE



1 1 RACK TR ELEVATION EXAMPLE

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TR ELEVATIONS

BASIS OF DESIGN EQUIPMENT

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VERIFIED BY: MICHAEL JULIAN, RCDD
JOHN WERNAU, KELLY BATES

DOC VERSION No: 4.0

ISSUE DATE: June 1, 2023

SHEET TITLE

BASIS OF DESIGN EQUIPMENT

GENREIC TELECOMMUNICATIONS MEDIA AND INTERFACE SPECIFICATIONS FOR TELECOMMUNICATIONS SPACES			
ID	PRIMARY ATTRIBUTE	SECONDARY ATTRIBUTE	SPECIFICATION
1	COPPER PATCH PANELS	PERFORMANCE CATEGORY	CATEGORY 6A (10 GBE)
		POSITION COUNT	48
		FORM FACTOR	ANGLED
		SIZE	ONE RACK UNIT (RU)
		JACK COLOR CODING	A-SIDE BLUE / B-SIDE YELLOW FOR DUAL PATH DISTRO WITHIN COMPUTER ROOMS (DATA CENTERS); UTP DISTRO TO WAOs IS EXCLUDED
2	FIBER DISTRIBUTION PANNELS	CASSETTE CAPACITY	12 CASSETTES OR 6 DOUBLE CASSETTES
		CASSETTE USER INTERFACES	LC DUPLEX CONNECTORS / MPO-8
		CASSETTE BACKBONE INTERFACES	MPO-24/MPO-12
		PERFORMANCE CHARACTERISTICS	OM4 LASER OPTIMIZED 50/125 MULTIMODE (MM) / OS1(OS2) 9/125 SINGLE MODE (SM)
		FORM FACTOR	ONE RU
3	UNSHIELDED TWISTED PAIR (UTP) (HORIZONTALAND FIRST LEVEL BACKBONE)	PERFORMANCE CATEGORY	CATEGORY 6A (10 GbE); 24-26 GAUGE
		PERFORMANCE SPECIFICATIONS	MEETS OR EXCEEDS TIA-EIA-568-C.2-10, TSB-155.
4	IBER (HORIZONTAL AND FIRST LEVEL BACKBONE	PERFORMANCE CATEGORY	OM4 LASER OPTIMIZED / OS1 / OS2
		PERFORMANCE SPECIFICATIONS	LASER OPTIMIZED 50/125 MM FIBERS WITH AT LEAST 4,700 MHZ·KM AT 850 NM / OS1 9/125 SM FIBERS (INTRA-BUILDING) / OS2 9/125 SM (INTER-BUILDING)
		MODE	MULTIMODE/SINGLE MODE
		JACK COLOR	AQUA (OM4) / LIME (OM5) / YELLOW (SM) / BLACK (OSP)
		MEDIA CONNECTOR	PRE-TERMINATE WITH MULTI-FIBER PUSH ON (MPO), (FIELD TERMINATION AUTHORIZED FOR DISTRIBUTION LEAVING THE COMPUTER ROOM)
		STRAND COUNT	12 or 24
		BUNDLING	LOOSE TUBE (OUTDOOR)/TIGHT BUFFERED (INDOOR)
5	UTP PATCH CORDS	PERFORMANCE CATEGORY	CATEGORY 6A, 26-28 GAUGE, STRANDED
		PERFORMANCE SPECIFICATIONS	CENTER TUNED TO HORIZONTAL MEDIA
		TERMINATION METHOD	FACTORY PRE-TERMINATED
6	FIBER PATCH CORDS	PERFORMANCE CATEGORY	OM5/ OM4 / OS1 / OS2
		PERFORMANCE SPECIFICATIONS	LASER OPTIMIZED 50/125 MM FIBERS WITH AT LEAST 4,700 MHZ·KM AT 850 NM / OS1 9/125 SM FIBERS (INTRA-BUILDING) / OS2 9/125 SM (INTER-BUILDING)
		MODE	MULTIMODE/SINGLE MODE
		JACKET COLOR	AQUA (OM4) / LIME (OM5) / YELLOW (SM)
		MEDIA CONNECTOR	PRE-TERMINATED WITH DUPLEX LC / MPO-8

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ENTERPRISE DATA CENTER AND INFRASTRUCTURE ENGINEERING

EDICT

ENTERPRISE DATA CENTER INFRASTRUCTURE COLLABORATION TEAM

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OIT DESIGN GUIDE TEMPLATES

PROJECT No:

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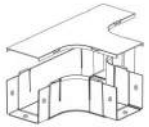
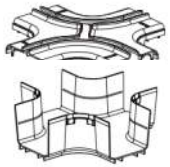
SPECIFICATIONS



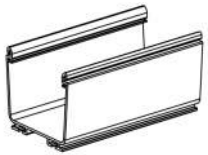


Fiber pathway channel corners (panduit fr4x4/frhc4/frshc4 or equivalent):

- Right angle corner
- Tee coner
- Tour way crossing
- Split or solid covers

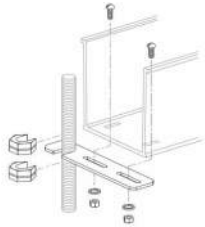
Fiber pathway bend radius spillways (panduit frvt4x4/frtr4x4 or equivalent):

- Vertical tee
- Trumpet spillway
- Bend radius spillways required at every rack location



Fiber pathway channel and covers (panduit fr4x4/frhc4/frshc4 or equivalent):

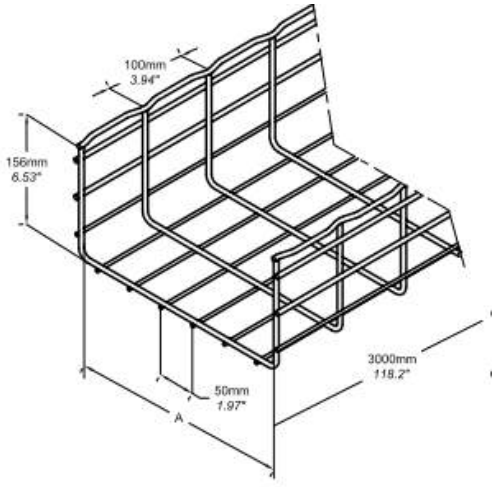
- 4 in. x 4 in. channel runner
- Solid cover
- Split hinged cover



Fiber pathway mounting bracket (panduit fr6trbe/fr6trbn or equivalent):

- Bracket to mount to existing threaded rod or
- Bracket to mount to new threaded rod

2 Proposed fiber pathway and Details



Recommended cable tray:

- Cablofil
- 4 in. Deep x 12 in. Wide minimum (size commensurate with distribution requirement)
- White powercoat
- Tray insert

CAT. NO	DEPTH (IN)	WIDTH (IN)	CAT 6a 4-pr PLENUM (0.35 in.)
CF105/300	4	12	248
CF105/450	4	18	373
CF105/500	4	20	414
CF105/600	4	24	497
CF150/150	6	6	186
CF150/200	6	8	238
CF150/300	6	12	357
CF150/450	6	18	536
CF150/500	6	20	596
CF150/600	6	24	715
CF150/900	6	36	1078

1 Cable tray capacity planning

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SHEET TITLE

Pathway Details

SHEET: 45 OF 57

B-SIDE JACK COLOR: YELLOW

RECOMMENDED UTP MEDIA: ATLAS-X1 COPPER TRUNKS

PART NUMBER: CTA-U6APO6LxxxF-CYNXA24N-CYNXA24N-CB01E WHERE XXX IS THE LENGTH IN FT

DESCRIPTION:
CAT 6A UTP CMP CABLE ASSEMBLY; BUNDLE OF 6 BLUE CABLES
BERK-TEK - LANMARK-10G2 (UTP) BRANDED CABLE USED, TIA/EIA WIRING T568B
TESTED TO ANSI/TIA 568.2-D
CUSTOM LABELING, NO PULLING EYE
FIRST END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH YELLOW JACK 24 IN. BREAKOUT LENGTH. SECOND END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH YELLOW JACK 24 IN. BREAKOUT LENGTH

3 B-SIDE UTP TRUNK CABLES

A-SIDE JACK COLOR: BLUE

RECOMMENDED UTP MEDIA: ATLAS-X1 COPPER TRUNKS

PART NUMBER: CTA-U6APO6LxxxF-CLNXA24N-CLNXA24N-CB01E WHERE XXX IS THE LENGTH IN FT

DESCRIPTION:
CAT 6A UTP CMP CABLE ASSEMBLY; BUNDLE OF 6 BLUE CABLES
BERK-TEK - LANMARK-10G2 (UTP) BRANDED CABLE USED, TIA/EIA WIRING T568B
TESTED TO ANSI/TIA 568.2-D
CUSTOM LABELING, NO PULLING EYE
FIRST END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH BLUE JACK 24 IN. BREAKOUT LENGTH. SECOND END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH BLUE JACK 24 IN. BREAKOUT LENGTH

2 A-SIDE UTP TRUNK CABLES

A-SIDE JACK COLOR: BLUE

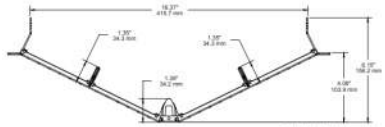
B-SIDE JACK COLOR: YELLOW

RECOMMENDED UTP MEDIA: ATLAS-X1 COPPER TRUNKS

PART NUMBER: CTA-U6APO6LxxxF-CLNXA24N-CYNXA24N-CB01E WHERE XXX IS THE LENGTH IN FT

DESCRIPTION:
CAT 6A UTP CMP CABLE ASSEMBLY; BUNDLE OF 6 BLUE CABLES
BERK-TEK - LANMARK-10G2 (UTP) BRANDED CABLE USED, TIA/EIA WIRING T568B
TESTED TO ANSI/TIA 568.2-D
CUSTOM LABELING, NO PULLING EYE
FIRST END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH BLUE JACK 24 IN. BREAKOUT LENGTH. SECOND END TERMINATION: ATLAS-X1 E2XHD CONNECTOR WITH YELLOW JACK 24 IN. BREAKOUT LENGTH

4 A-SIDE TO B-SIDE CROSS CONNECT UTP TRUNK CABLES



RECOMMENDED UTP PATCH PANEL
LEVITON E2XHD-BLK HIGH-DENSITY ANGLED
48 POSITION
ONE RU PER PANEL
WITH REAR CABLE MANAGER
ANGLED PANEL COVERS

1 UTP PATCH PANEL

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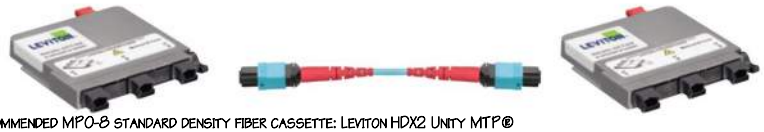
UTP MEDIA DETAILS



Recommended MPO-8 standard density fiber cassette: Leviton HDX2 Unity MTP®

Part number: 42NM2-S5C
Description:
HDX Unity MTP® cassette, (0.75 dB) 24-fiber OM4, 3x8-fiber MTP®(male) to 1x24-fiber MTP®(male), 120G to 40G, black latch
universal polarity cassettes

Recommended MPO-24 trunk cable: Opt-X™ unity ultra low loss MTP® trunk cables
Part Number: FTU-FW4024JJxxxF36C36CY-NNBS Where xxx is the length in ft
Description: Fiber trunk unity; 24 Fibers, Multimode OM4; 24F Sub-Units Opt-X SJP; First end with pulling eye, custom label; Polarity MTP® method B; First end connector: 24F LLMTP 0.35 dB female connector, breakout length of 36 in. into 3.6 mm jacketed fiber, no sstagger; SecondeEndcConnector: 24F LLMTP 0.35 dB female connector,bBreakout length of 36 in. into 3.6 mm jacketed fiber,NNo sStagger;

4 Fiber cassettes and trunk cables (SD MPO-8 breakout)

Recommended LC fiber cassette: Leviton HDX2 Unity MTP®

Part Number: 41LSM4-UNN
Description:
HDX Unity MTP® cassette, (0.35 dB), 12-Fiber OM4, LC Shuttered (Aqua) to 1x12-fiber MTP®, universal polarity, black latch
universal polarity cassettes

Recommended MPO-12 trunk cable: Opt-X™ Unity ultra low loss MTP® trunk cables
Part Number: FTU-FW2012LLxxxF36B36BY-NNBC where xxx is the length in ft
Description: Fiber trunk unity; 12 fibers, multimode OM4; 12F Sub-Units Opt-X SJP; Overall cable length of 100 ft; First end with pulling eye, custom label; Polarity MTP method B; First end connector: 12F ULMTP 0.20 dB female connector, breakout length of 36 in. into 2 mm jacketed fiber, no stagger; Second end connector: 12F ULMTP 0.20 dB female connector, breakout length of 36 in. into 2 mm jacketed fiber, no stagger;

3 Fiber cassettes and trunk cables (LC MPO-12 breakout)

Recommended LC fiber cassette: Leviton HDX2 Unity MTP®

Part Number: 42LSM2-21C
Description:
HDX2 Unity MTP® cassette, (0.50 dB) 24-fiber OM4, LC shuttered to 1x24-fiber MTP®(male), 120G to 10G, black latch
universal polarity cassettes

Recommended MPO-24 trunk cable: Opt-X™ Unity ultra low loss MTP® trunk cables
Part Number: FTU-FW4024JJxxxF36C36CY-NNBS Where xxx is the length in ft
Description: Fiber trunk unity; 24 fibers, multimode OM4; 24F sub-units Opt-X SJP; First end with pulling eye, custom label; Polarity MTP method B; First end connector: 24F LLMTP 0.35 dB female connector, breakout length of 36 in. into 3.6 mm jacketed fiber, no stagger; Second end connector: 24F LLMTP 0.35 dB female connector, breakout length of 36 in. into 3.6 mm jacketed fiber, no stagger;

2 Fiber cassettes and trunk cables (LC MPO-24 breakout)

Recommended LC fiber splice cassette:
Leviton HDX

Part number: SPLCH-12AQ (OM4) / SPLCH-12GN (OS2)
Description:
HDX OM4 LC cassette, (0.15 dB) 12-fiber OM4 to 12x1-fiber LC(UPC)
HDX OS2 LC cassette, (0.24 dB) 12-fiber OS2 to 12x1-fiber LC(APC)

5 Fiber splice cassettes (LC breakout)

Recommended MPO-8 to MPO-8 patch cords:

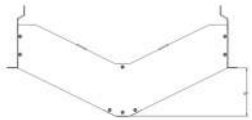
Leviton Opt-X™ Unity ultra low loss array cords
Part number: UL548MM-BxxxF where xxx is the length in ft
Description: Opt-X® Unity 40-100G MTP® array cord (3 mm round cable), multimode (OM4), 8 fibers, ULMTP 8 fiber female to ULMTP 8 fiber female, method B polarity

Recommended LC to LC patch cords:

Leviton premium plus fiber patch cords

- OM4: Part number: PCF-M4PD1RR-xxxxF where xxxx is the length in ft to 0.5 ft. (Example: For 5 ft xxxx=0050, for 3.5 ft xxxx=0035)
  Description: premium plus fiber patch cord, OM4 aqua, plenum, DUP-ZIP 1.6 mm, LC, LC, Ultra Polished Connectors (UPC)
- OS2: Part number: PCF-S2PD1FF-xxxxFAB where xxxx is the length in ft to 0.5 ft. (Example: For 5 ft xxxx=0050, for 3.5 ft xxxx=0035)
  Description: Premium plus fiber patch cord, OS2 yellow, plenum, DUP-ZIP 1.6 mm, LC/APC, LC/APC, A-B polarity (Part number PCF-S2PD1FF-xxxxFAA for A-A polarity)

6 Fiber patch cords



Recommended fiber distribution panel:
Leviton angled Opt-X™ UHDX
144 fiber
One RU

1 Fiber distribution panel

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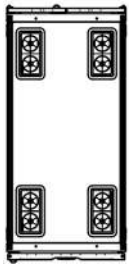
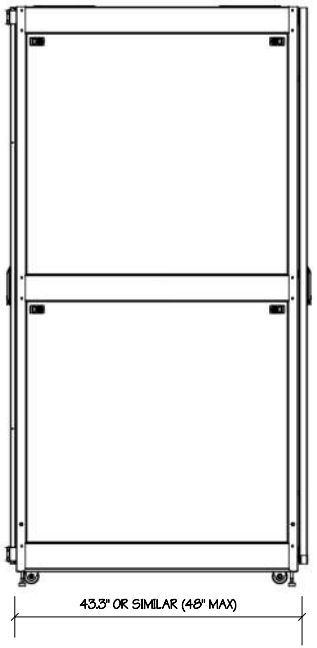
Fiber Media Details

SHEET: 47 OF 57



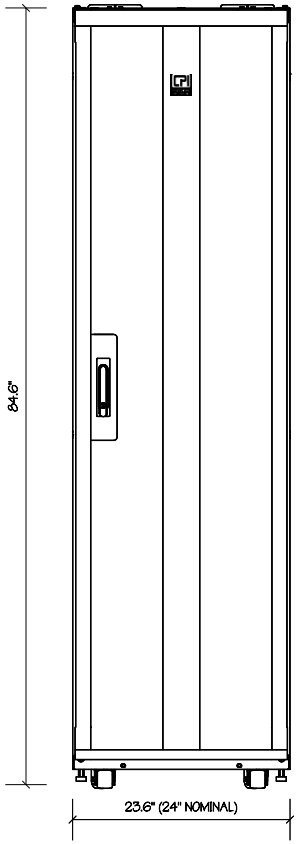
TYPICAL SERVER CABINET TOP VIEW WITH FOUR BRUSHED GROMMET CABLE OPENINGS

4



3 TYPICAL SERVER CABINET SIDE VIEW

Note: SERVER CABINETS MAY ONLY HOUSE SERVER AND STORAGE EQUIPMENT AND SUPPORTING PATCH PANELS. SERVER CABINETS MAY NOT HOUSE TELECOMMUNICATIONS (NETWORK) EQUIPMENT.



2 TYPICAL SERVER CABINET FRONT

CHATSWORTH ZETAFRAME™ CABINET (PN:ZB14-A222A-E1) OR EQUIVALENT

23.6 IN. (600 MM) W X 43.3 IN. (1100 MM)D X 45RMU;GLACIER WHITE;(1) CASTER ONLY KIT;(1) LEVELER ONLY KIT;(4) SQUARE PUNCHED RAILS WITH NO CABLE OPENINGS;(2) SOLID SIDE PANEL;(1) ZETAFRAME PERFORATED METAL DOOR, GLACIER WHITE;(1) SINGLE-POINT KEYED LOCK;(1) DOUBLE PERFORATED METAL DOOR;(1) THREE-POINT KEYED LOCK;(1) TOP PANEL WITH FOUR (4) BRUSH-SEALED CABLE OPENINGS;(1) BOTTOM PANEL WITH TWO (2) BRUSHED-SEALED CABLE OPENINGS ;(1) AIR DAM KIT;(1) STANDARD DUAL 2-PIECE PDU BRACKET KIT;(1) COMMON PARTS KIT, ZF, UL;(1) PACKAGING KIT

Z	1	2	3	-	4	5	6	7	8	-	9	10

1. Height

U	in	mm	
42	79.4	2017	A
45	84.6	2149	B
48	89.9	2283	C
52	96.9	2461	D

Height includes casters.

2. Width

in	mm	
23.6	600	1
27.6	700	2
29.5	750	3
31.5	800	4

3. Depth

in	mm	
31.5	800	1
39.4	1000	2
41.3	1050	3
43.3	1100	4
47.2	1200	5

Frame depth does not include doors. See detailed dimensions on page 6.

4. Doors

None	0
Single Perforated Front/ Double Perforated Rear	A
No Front/ Double Perforated Rear	B

5. Top Panel

0	None
1	Grommet-Sealed
2	Brush-Sealed

6. Side Panel

0	None
1	1 Side
2	2 Sides

7. Bottom Panel

0	None
1	Grommet-Sealed
2	Brush-Sealed

8. Thermal Management

0	None
A	Air Dam
B	Air Dam, Brushed-Sealed Rail

Brush-Sealed Front Rails are not available for 23.6"W (600 mm) cabinets.

9. Color

7	Black
E	Glacier White

10. Shipping

1	Standard Pallet
2	Shock Pallet

Shock Pallet is available for 42U, 45U, 48U cabinet heights and 43.3"D (1100 mm) and 47.2"D (1200 mm) cabinet depths.

1 TYPICAL SERVER CABINET SPECIFICATION

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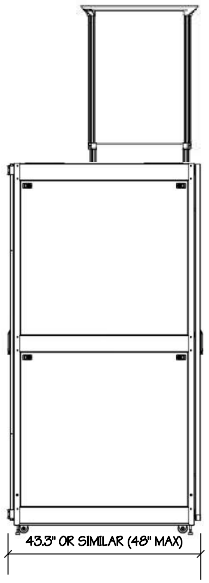
SHEET TITLE

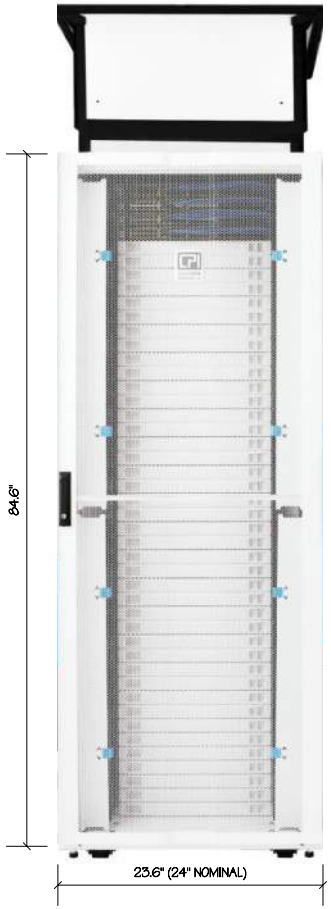
TYPICAL SERVER CABINET

4 TYPICAL ENCLOSURE TOP VIEW WITH VERTICAL EXHAUST DUCT (VED)
NTS



3 TYPICAL ENCLOSURE SIDE VIEW WITH VERTICAL EXHAUST DUCT (VED)
NTS

NOTE: SERVER CABINETS MAY ONLY HOUSE SERVER AND STORAGE EQUIPMENT AND SUPPORTING PATCH PANELS. SERVER CABINETS MAY NOT HOUSE TELECOMMUNICATIONS (NETWORK) EQUIPMENT



2 TYPICAL ENCLOSURE FRONT WITH VERTICAL EXHAUST DUCT (VED)
NTS

CHATSWORTH ZETAFRAME™ CABINET (PN:ZB14-DX22A-E1) OR EQUIVALENT

ZETAFRAME CABINET; 84.6 IN. H X 23.6 IN. W X 43.3 IN. D (2149 MM X 600 MM X 1100 MM); 45 RU; 2 PAIR SQUARE PUNCHED RAILS; PERF FRONT DOOR; SOLID REAR DOOR; VED 20 IN. H-34 IN. H (508 MM – 863 MM); 2 SIDE PANELS; BRUSH BOTTOM PANEL; AIR DAM; STANDARD PALLET; GLACIER WHITE

VED SIZE DEPENDS UPON FINAL ELEVATION DRAWINGS

Z	1	2	3	-	4	5	6	7	8	-	9	10

1. Height

U	in	mm	
42	79.4	2017	A
45	84.6	2149	B
48	89.9	2283	C
52	96.9	2461	D

Height includes casters.

2. Width

in	mm	
23.6	600	1
27.6	700	2
29.5	750	3
31.5	800	4

3. Depth

in	mm	
41.3	1050	3
43.3	1100	4
47.2	1200	5

Frame depth does not include doors. See detailed dimensions on page 6.

4. Doors

Single Perforated Front/ Single Solid Rear	D
No Front/ Single Solid Rear	E

5. Top Panel

A	15-20" H (381 - 508 mm) Vertical Exhaust Duct
B	20-34" H (508 - 863 mm) Vertical Exhaust Duct
C	34-60" H (863 - 1524 mm) Vertical Exhaust Duct
D	15-20" H (381 - 508 mm) Vertical Exhaust Duct, Air Director
E	20-34" H (508 - 863 mm) Vertical Exhaust Duct, Air Director
F	34-60" H (863 - 1524 mm) Vertical Exhaust Duct, Air Director

A half brush seal is included at the lower rear of the duct.

6. Side Panel

0	None
1	1 Side
2	2 Sides

At least one side panel between adjacent cabinets and bottom panel are recommended for optimal thermal performance.

7. Bottom Panel

0	None
1	Grommet-Sealed
2	Brush-Sealed

8. Thermal Management

A	Air Dam
B	Air Dam, Brushed-Sealed Front Rail

Brush-Sealed Front Rails are not available for 23.6" W (600 mm) cabinets.

9. Color

7	Black
E	Glacier White

10. Shipping

1	Standard Pallet

1 TYPICAL ENCLOSURE SPECIFICATION
NTS

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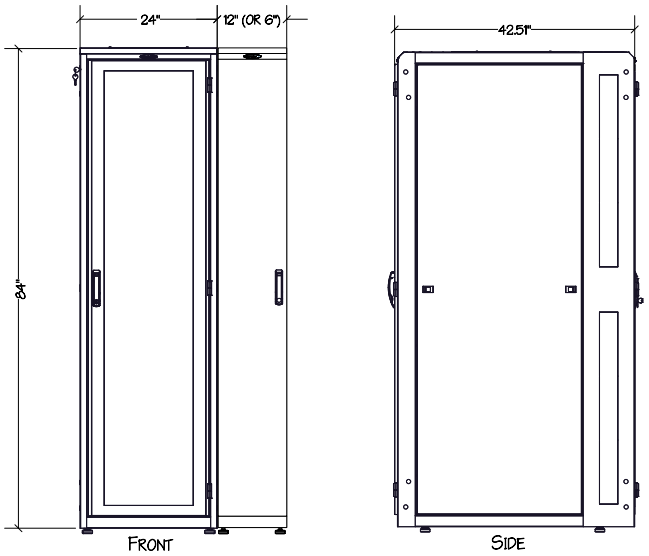
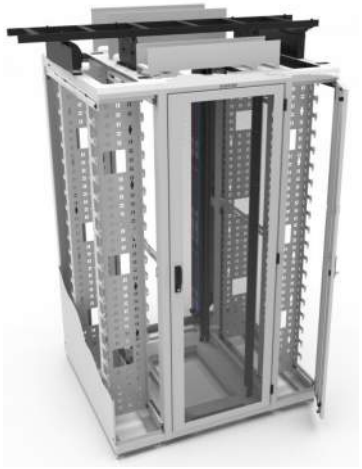
DOC VERSION No: 4.0
ISSUE DATE: June 1, 2023

SHEET TITLE
TYPICAL SERVER CABINET WITH VERTICAL EXHAUST DUCT



4 TYPICAL NETWORK CABINET (WITH SIDECAR) FRONT AND SIDE VIEW DIMENSIONS

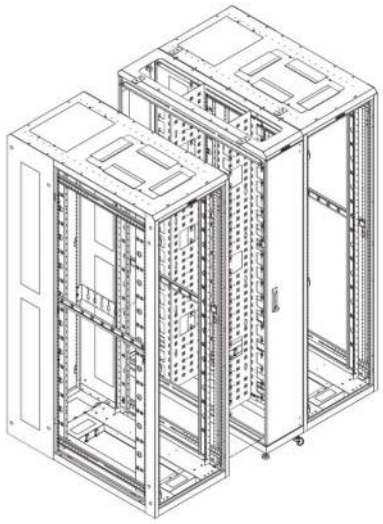


5 PHOTOGRAPHIC ISOMETRIC VIEW OF CABINET WITH SIDECARS

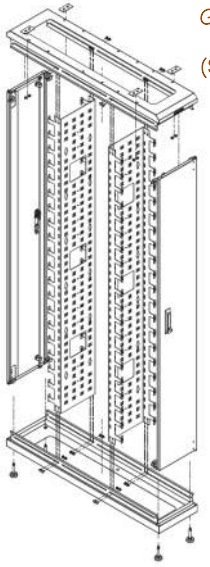
NOTE: NETWORK CABINETS ARE PURPOSE BUILT TO PROVIDE AMPLE ROOM FOR CABLING NEEDS OF THE HORIZONTAL DISTRIBUTION AREA AND THE MAIN DISTRIBUTION AREA AND MAY BE USED IN LIEU OF TELECOMMUNICATION CHANNEL RACKS FOR THIS PURPOSE. TELECOMMUNICATION CABINETS MAY NOT BE USED IN TELECOMMUNICATIONS ROOMS.

GREAT LAKES CASE AND CABINET ES CABINET (GL840ES-2442-W-MSS) OR EQUIVALENT

- 84 IN. H X 24 IN. W X 42 IN. D
- 44 RU
- 40 IN. USABLE DEPTH
- 35 IN. MAX. RAIL SPACING
- 3300 LB. WEIGHT CAPACITY
- WINTER CHITE
- INCLUDES: FRAME WITH LEVELERS (2.5 IN. H) AND TWO PAIRS OF PDU BRACKETS; MESH CONTOUR FRONT DOOR; SPLIT MESH REAR DOOR; SOLID (2) SIDE PANEL; 3/8 IN. SQ. (M6) MOUNTING RAILS WITH RACK MOUNT HARDWARE; SOLID TOP PANEL
- UL2416
- SHIPPING DIMS: 89 IN. H X 32 IN. W X 45 IN. D; 416 LB.



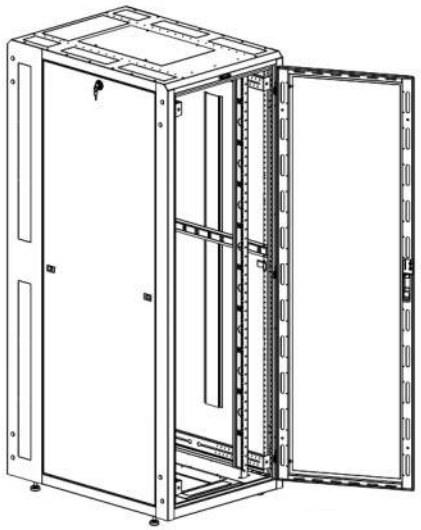
3 TYPICAL NETWORK CABINET ISOMETRIC VIEW



GREAT LAKES CASE AND CABINET CABLE MANAGEMENT SIDECAR (SC128442 OR SC68442) OR EQUIVALENT

- 84 IN. H X 6 IN. W (OR 12 IN. W) X 42 IN. D
- INCLUDES DEPTH ADJUSTABLE TROUGHS
- DUAL-HINGE FRONT AND REAR DOORS
- USE WITH ES CABINETS

2 TYPICAL CABLE MANAGEMENT SIDECAR



1 TYPICAL NETWORK CABINET SPECIFICATION

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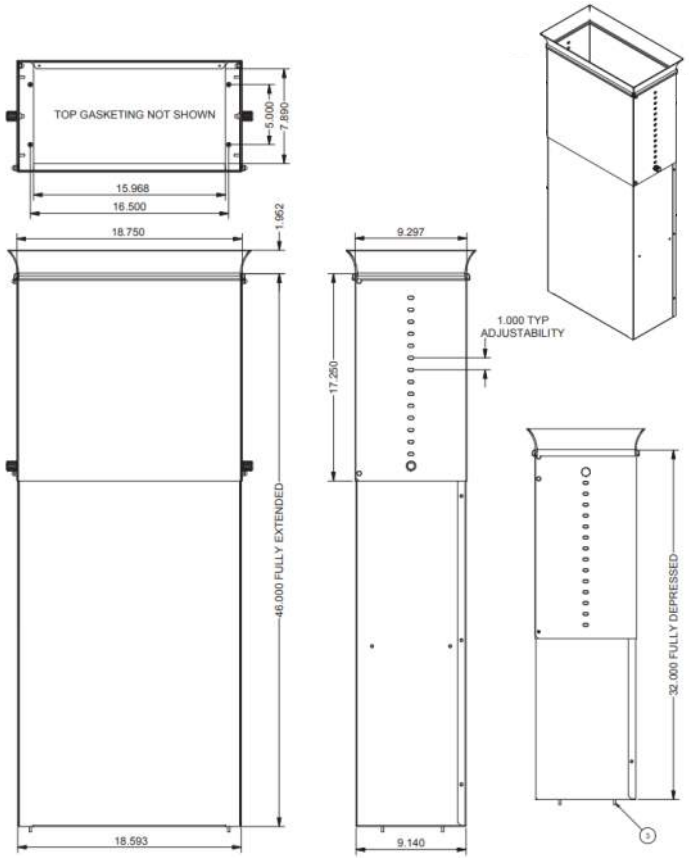
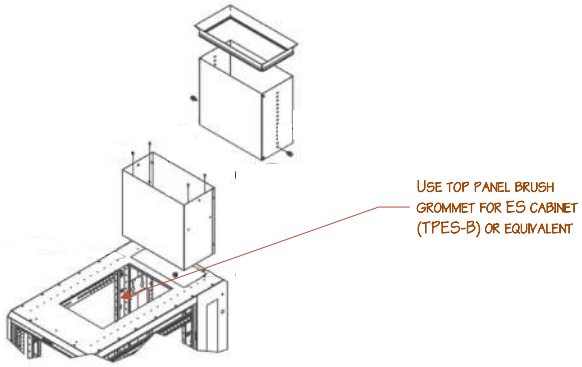
GREAT LAKES CASE AND CABINETS EXHAUST CHIMNEY OR EQUIVALENT

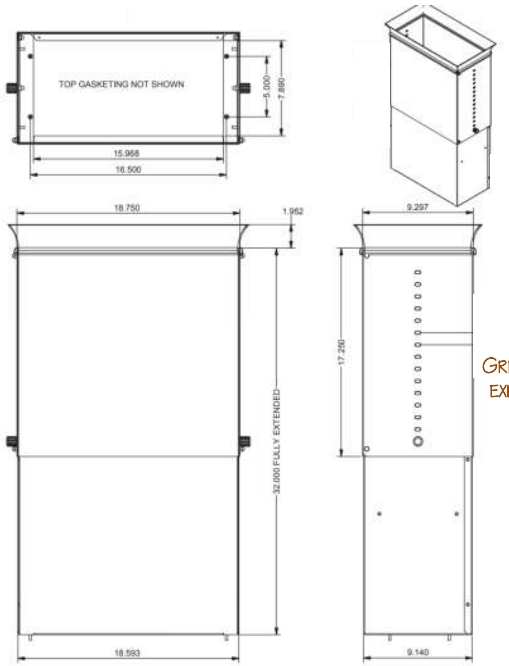
GL-EC-42-3246 CHIMNEY, 32-46 IN. 42 IN. D ES SIZES



2 TYPICAL RACK WITH VERTICAL EXHAUST DUCT FRONT AND SIDE VIEW DIMENSIONS



3 TYPICAL RACK WITH VERTICAL EXHAUST DUCT ISOMETRIC VIEW



GREAT LAKES CASE AND CABINETS EXHAUST CHIMNEY PR EQUIVALENT

GL-EC-42-1832 CHIMNEY, 18-32 IN. 42 IN. D ES SIZES

1 TYPICAL RACK WITH VERTICAL EXHAUST DUCT FRONT AND SIDE VIEW DIMENSIONS

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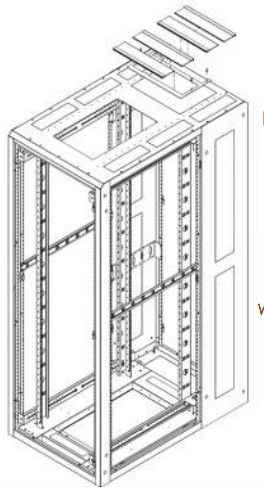
TYPICAL NETWORK CABINET WITH VERTICAL EXHAUST DUCT

BRUSH GROMMET CHIMNEY KNOCKOUT



BRUSH GROMMET (AND EDGE GROMMET) TO COVER CABLE PASS-THRU KNOCKOUTS

USE FOR TOP CHIMNEY KNOCKOUT ON 42 IN. D ES CABINETS WHEN VERTICAL EXHAUST DUCT IS NOT USED

4 TYPICAL BRUSH GROMETS – CHIMNEY KNOCKOUT

TOP PANEL BRUSH GROMMET FOR ES CABINETS (TPES-B)

OR EQUIVALENT

6 TYPICAL TOP PANEL COVER WITH BRUSH GROMMETS

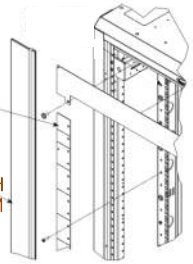
BRUSH GROMMET RAIL KIT

BGRK-84-24
OR EQUIVALENT

84 IN. H X 24 IN. W ES SIZES

OPTIONAL BREAKAWAY TRIM

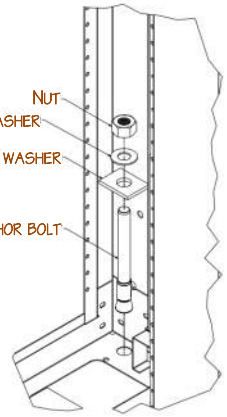
BRUSH STRIP WITH FLEXIBLE PVC TRIM



5 TYPICAL BRUSH GROMMETS – FRONT RAILS

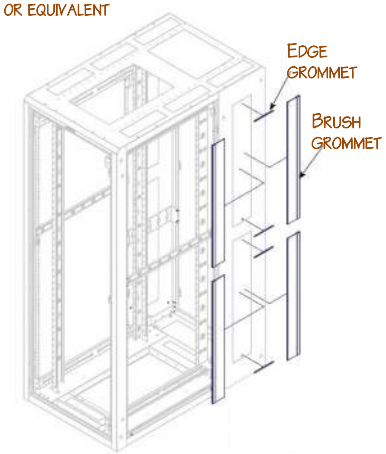
SEISMIC ANCHOR KIT INCLUDES 4 TORQUE CONTROLLED EXPANSION ANCHORS

AK101
OR EQUIVALENT



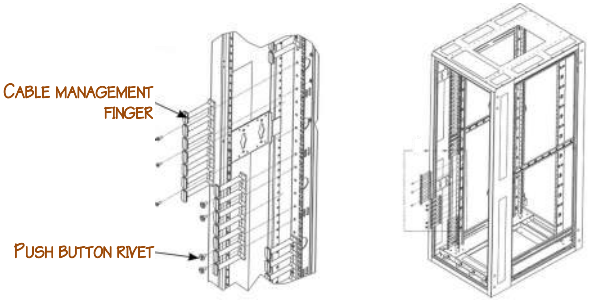
7 TYPICAL SEISMIC ANCHOR KIT

BRUSH GROMMET FOR CABLE PASS THRU (BGS-84) OR EQUIVALENT



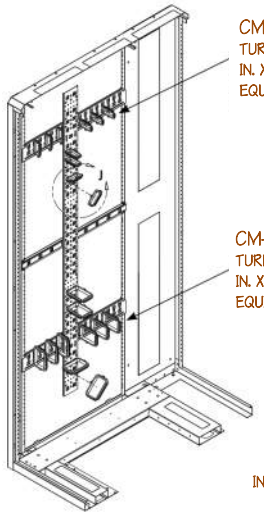
3 TYPICAL BRUSH GROMMETS – SIDE WALL PASS THRU

CABLE MANAGEMENT FINGERS

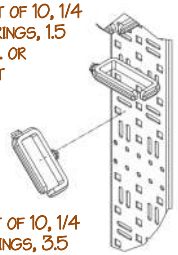


CM-47 4 IN. X 7 RMU, SINGLE FINGER SECTION
ESC-K12 4 IN. X 7 RMU, SET OF 12 FINGER SECTIONS
CM-77 7 IN. X 7 RMU, SINGLE FINGER SECTION
ESC-K12-7 7 IN. X 7 RMU, SET OF 12 FINGER SECTIONS
OR EQUIVALENT

2 TYPICAL CABLE MANAGEMENT FINGERS



CM-25 KIT OF 10, 1/4 TURN "D" RINGS, 1.5 IN. X 3.5 IN. OR EQUIVALENT



CM-26 KIT OF 10, 1/4 TURN "D" RINGS, 3.5 IN. X 5 IN. OR EQUIVALENT

VERTICAL AND HORIZONTAL INTERNAL CABLE MANAGEMENT BARS (VCB8436) OR EQUIVALENT

1 TYPICAL CABLE MANAGEMENT BARS

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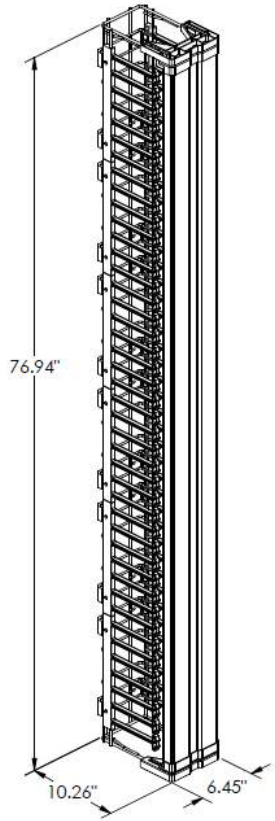
TYPICAL NETWORK CABINET ACCESSORIES



P/N: OR-MM20VMD706 (OR EQUIVALENT)

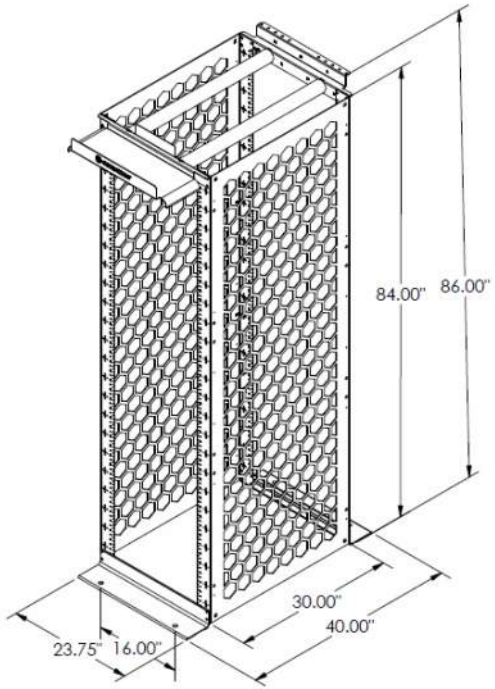
MM20 VERTICAL CABLE MANAGEMENT "CAGE", WITH DOOR, 6.45 IN. X 10.26 IN. X 76.94 IN. WHITE

CAPACITY: 350 CATEGORY 6A PATCH CORDS OR 245 CATEGORY 6A PATCH CORDS

LARGER VCM AUTHORIZED IN ACCORDANCE WITH CABLING REQUIREMENT

3 6 IN. WIDE VERTICAL CABLE MANAGEMENT

NOTE: TELECOMMUNICATION CHANNEL RACKS ARE REQUIRED IN ALL TELECOMMUNICATION ROOMS. TELECOMMUNICATION CHANNEL RACKS OR TELECOMMUNICATION CABINETS MAY BE USED IN THE HORIZONTAL AND MAIN DISTRIBUTION AREAS.

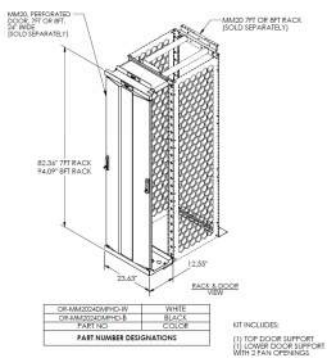


P/N: OR-MM2073038-W (OR EQUIVALENT)

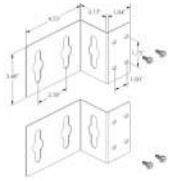
MIGHTY MO 20 CABLE MANAGEMENT RACK
30 IN. CHANNEL DEPTH, 7 FT HIGH, WHITE FINISH OR EQUIVALENT

DIMENSIONS:
USABLE HEIGHT: 45 RU
DEPTH (US): 30 IN.
HEIGHT (US): 7 FT
WIDTH (US): 23.75 IN.
STATIC LOAD CAPACITY: 2000 LB
SQUARE HOLE

2 TYPICAL RACK DIMENSIONS AND SPECIFICATIONS



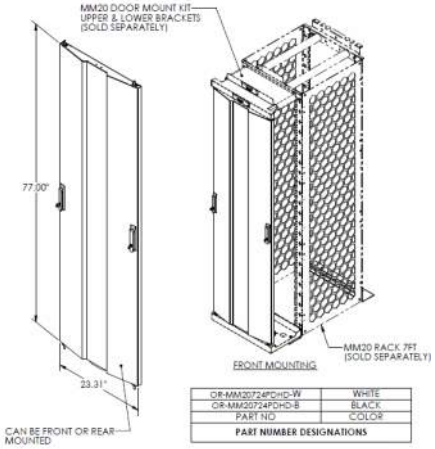
4 SECURITY DOOR FRONT MOUNTAING HARDWARE (OR-MM2024DMFHD-W)



PDU MOUNTING BRAACKET KIT (TWO KITS PER RACK)
P/N: OR-MM20PDUMB1D2W-W

6

5 SECURITY DOOR REAR MOUNTING HARDWARE (OR-MM2024DMRHD-W)



1 FRONT AND REAR HEAVY DUTY PERFORATED SECURITY DOOR (OR-MM20724PDHD-W) (OPTIONAL)

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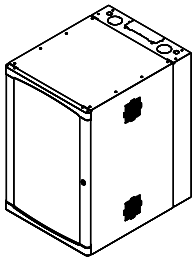
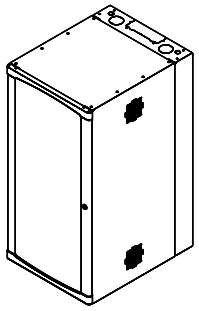




SPECIFICATIONS

DESCRIPTION:
WALL-MOUNT ENCLOSURE WITH LOCKABLE FRONT DOOR AND SWING-OUT REAR ACCESS TO EQUIPMENT. TEMPERED GLASS FRONT DOOR

26 RU:
CUBE-IT WALL-MOUNT CABINET; GEN 3; 48 IN. H X 24 IN. W X 30 IN. D (1220 MM X 610 MM X 760 MM); 26 RU; #12-24 TAPPED RAILS; TEMPERED GLASS ROOR; GLACIER QHITE. 12419-E48 CUBE-IT OR EQUIVALENT

12 RU:
CUBE-IT WALL-MOUNT CABINET; GEN 3; 24 IN. H X 24 IN. W X 30 IN. D (610 MM X 610 MM X 760 MM); 12 RU; #12-24 TAPPED RAILS; TEMPERED GLASS DOOR; GLACIER WHITE. 12419-E24 CUBE-IT OR EQUIVALENT

USE:
FOR INDOOR USE ONLY, IN ENVIRONMENTALLY CONTROLLED AREAS; MAY NOT BE USED OUTDOORS, IN HARSH ENVIRONMENTS, OR IN AIR-HANDLING SPACES
SIZE:
HEIGHT: 48 IN. (1220 MM)
WIDTH: 24 IN. (610 MM); 19 IN. EIA RACK-MOUNT
DEPTH: 30 IN. (760 MM)
INTERIOR:
HEIGHT: 26 RU
WIDTH: 19 IN. EIA RACK-MOUNT
THREADED #12-24 EQUIPMENT MOUNTING HOLES
19 IN. W, EIA-310-D COMPLIANT
FAN ASSEMBLIES WITH FILTER KITS

4 SPECIFICATIONS

Cable Port Brush Kit for CUBE-iT Wall-Mount Cabinet
- Optional cover when rectangular knockout on the rear panel is removed
- Seals opening around cables with brush seal
- Sold in pairs

Part Number	Description	Shipping Weight lb (kg)
25190-000	0.8"H x 10.6"W x 2.9"D (20 mm x 268 mm x 74 mm)	2 (0.9)

3 BRUSH KIT (ONE PER CABINET)

Equipment Mounting Rail Kit for CUBE-iT Wall-Mount Cabinet
- Use with equipment that needs front and rear support
- Sold in pairs
- Aluminum material

Part Number	Description	Shipping Weight lb (kg)
12787-524	12U; For 24"H (610 mm) cabinet	4 (1.8)
12787-536	19U; For 36"H (910 mm) cabinet	6 (2.7)
12787-548	26U; For 48"H (1220 mm) cabinet	8 (3.6)

9 FRONT AND REAR RAIL KIT

Low-Decibel Dual-Fan and Filter Kit for CUBE-iT Wall-Mount Cabinet
- Pressurizes interior of the cabinet, forcing warm air out of open vents
- Assembly includes 2 fans and 2 filters
- Noise Level: 31 dB (measured at 3' (1 m) distance)
- Recommended placement on bottom right and left sides of the cabinet
- Airflow: 120 CFM (204 CMH)
- 50/16 Hz
- 6'L (1.8 m) NEMA 5-15P/6-15P Power Cord

Part Number	Description	Shipping Weight lb (kg)
40975-001	115 Volt; 5-15P power cord	4 (1.8)
40975-002	230 Volt, 6-15P Power cord	4 (1.8)

7 FAN KIT QTY 1 PER CABINET

- FOR USE WITH SMALL EQUIPMENT SUCH AS MODEMS, ROUTERS AND FIBER MODULES IN 19 IN. EIA RACKS
- 1 RU; INCLUDES MULTIPLES TIE-DOWN POINTS
- SUPPORTS UP TO 20 LB (9.1 KG) OF EQUIPMENT

5 SHELF (TWO PER CABINET)

Vertical Cabling Section for CUBE-iT Wall-Mount Cabinet
- Attaches to the outside edge of equipment mounting rails
- 4U height; openings align with rack-mount unit spaces on equipment mounting rails
- Sold in pairs
- Order additional kits as-needed per cable management requirements

Part Number	Description	Shipping Weight lb (kg)
40970-704	4U, 7"H x 0.5"D (178 mm x 13 mm)	3 (1.4)
40970-707	7U, 12.3"H x 0.5"D (311 mm x 13 mm)	3 (1.4)
40970-711	11U, 19.3"H x 0.5"D (489 mm x 13 mm)	4 (1.8)

Color is black.

2 VERTICAL CABLE MANAGEMENT. TWO KITS FOR 26 RU TE. ONE KIT FOR 12 RU TE

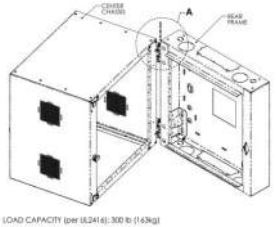
Replacement Filter Kit for CUBE-iT Wall-Mount Cabinet
- Compatible with Low-Decibel Dual-Fan and Standard Fan kits

Part Number	Description	Shipping Weight lb (kg)
40973-001	Pack of 5	2 (0.9)

LED Light Kit for CUBE-iT Cabinets
- Attaches to the bottom, top or side of CUBE-iT Cabinets
- Toggle switch, 4W LED light
- Detachable, 120 VAC with NEMA 1-15P Power Cord

Part Number	Description	Shipping Weight lb (kg)
12803-701	LED Light Kit, 4W, 120 Vac	2 (0.9)

8 FAN FILTER KIT AND LIGHT KIT(ONE PER CABINET).



6 REAR HINGE AND PANEL

Ground Jumpers
- Provide common bonding from equipment rack or cabinet to halo conductor
- Available individually or in packages of 10
- Constructed of UL Listed components

Part Number	Description	Shipping Weight lb (kg)
40159-009	9' (2.7 m) Ground Jumper, 1 Each	2 (0.9)
40159-019	9' (2.7 m) Ground Jumper, 10 Each	20 (1.9)

1 REQUIRED GROUND JUMPERS

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FILE: OIT_DESIGN_GUIDE_TEMPLATES-V4 - TD.VSDX
DESIGN BY: KEVIN GRZELKA, CTDC
VERIFIED BY: MICHAEL JULIAN, RCDD; JOHN WERNAU, KELLY BATES
DOC VERSION No: 4.0
ISSUE DATE: June 1, 2023
SHEET TITLE
TYPICAL TE CABINET

30 A THREE-PHASE ZONE PDU BASE UNIT – REAR CIRCUITS WITH FOUR L21-20R AND SIX NEMA 5-20 OUTLETS AND TWO 10 FT POWER CORDS TERMINATING IN L21-30P
ZONIT ZPDS-208V30A-L21-4L21-20R-CR OR EQUIVALENT

ZONE PDU INPUTS
REQUIRE TWO L21-30RS

NOTE: THE CORRECT SPECIFICATION FOR THE ZONE PDU IS TO ENERGIZE IT FROM TWO INDEPENDENT POWER SOURCES. EACH INPUT WILL USE IDENTICAL SPECS: WYE (5-WIRE), 208 V, 30 A, THREE-PHASE, TERMINATING IN A NEMA L21-30R LOCKING RECEPTACLE. THE NEUTRAL CONDUCTOR SHOULD BE UPSIZED ONE GAUGE TO MATCH THE UPSIZED NEUTRAL CONDUCTORS IN THE ZONE PDU UNITS. THE NEUTRAL "UPSIZING" SHOULD IDEALLY BE CONTINUED IN THE POWER DISTRIBUTION SYSTEM BACK TO THE UPS OR TRANSFORMER WINDING POLE. THIS INCREASES THE EFFICIENCY OF THE POWER DISTRIBUTION SYSTEM AND SUPPRESSES HARMONICS IN THE SYSTEM.

4 TYPICAL 30A ZONE PDU

60 A THREE-PHASE ZONE PDU BASE UNIT - REAR SIX L21-20R OUTPUT RECEPTACLES WITH 10 FT POWER CORDS TERMINATING IN HARDWIRE BOX
ZONIT ZPDS-208V60A-HW-6L21-20R OR EQUIVALENT

SPECIFICATIONS:
- RATED INPUT VOLTAGE: 208 V THREE-PHASE; AMPERAGE: 60 A
- INPUT CORD TERMINATION: HARDWIRE BOX
- OUTPUT RECEPTACLES: SIX L21-20R
- OUTPUT BRANCH CIRCUIT PROTECTION:
  - INDIVIDUAL 20 A CIRCUIT BREAKERS PROTECT EACH OUTPUT PHASE OF EACH OUTPUT RECEPTACLE

NOTE: THE CORRECT SPECIFICATION FOR THE ZONE PDU IS TO ENERGIZE IT FROM TWO INDEPENDENT POWER SOURCES. EACH INPUT WILL USE IDENTICAL SPECS: WYE (5-WIRE), 208 V, 60 A, THREE-PHASE, TERMINATING IN A JUNCTION BOX TO BE HARDWIRED INTO THE ZONE PDU. THE NEUTRAL CONDUCTOR SHOULD BE UPSIZED ONE GAUGE TO MATCH THE UPSIZED NEUTRAL CONDUCTORS IN THE ZONE PDU UNITS. THE NEUTRAL "UPSIZING" SHOULD IDEALLY BE CONTINUED IN THE POWER DISTRIBUTION SYSTEM BACK TO THE UPS OR TRANSFORMER WINDING POLE. THIS INCREASES THE EFFICIENCY OF THE POWER DISTRIBUTION SYSTEM AND SUPPRESSES HARMONICS IN THE SYSTEM.

5 TYPICAL 60A ZONE PDU

APC AP9560 OR EQUIVALENT RACK MOUNT PDU; L5-30 PLUG;
(10) NEMA 5-20 OUTLETS; 1 RU; TWO PER ENCLOSURE;
ONE ENERGIZED BY UPS; ONE ENERGIZED BY WALL OUTLET

REQUIRES ONE L5-30R

NOTE: USED IN TELECOMMUNICATIONS ENCLOSURES ONLY

3 120V RACK PDU FOR TES

APC AP8861 RPDU OR EQUIVALENT; RACK PDU 2G, METERED; L21-20 PLUG; THREE-PHASE; 120/208 V INPUT; 20 A; ZERO U; 5.7 KW, 208V, (36) C13 & (6) C19 & (2) 5-20 OUTLETS; FOR USE IN TELECOMMUNICATIONS ROOMS AND LOCATIONS WITH LEGACY 110 V ONLY EQUIPMENT

REQUIRES ONE L21-20R

NOTE: USED IN TELECOMMUNICATIONS ROOMS AND ENTRANCE ROOMS WHERE 110 V DISTRIBUTION USING NEMA 5-15 OR NEMA 5-20 RECEPTACLES ARE REQUIRED IN ADDITION TO THE STANDARD 208 V

2 208V RACK PDU FOR TRS AND ENTRANCE ROOMS

CHATSWORTH ECONNECT PDU OR EQUIVALENT; VERTICAL; MONITORED; L21-20 PLUG; THREE-PHASE; 120/208 V INPUT; 20 A; (30) C13 (6) C19 OUTLETS; 208 V OUTPUT; 3 X 2P 20 A; LCD; ETHERNET, USB, AND ENVIRONMENTAL SENSOR PORTS; IP AND SERIAL MONITORING; IP CONSOLIDATION (PDU LINKING); TOOL-LESS MOUNTING; 70.5 IN. H (1791 MM) X 2.2 IN. W (56 MM) X 2.2 IN. D (56 MM)

REQUIRES ONE L21-20R

1 208V RACK PDU FOR COMPUTER ROOMS

DEPARTMENT OF VETERANS AFFAIRS
OFFICE OF INFORMATION AND TECHNOLOGY
INFRASTRUCTURE OPERATIONS - APPLICATION HOSTING, CLOUD AND EDGE SOLUTIONS
ENTERPRISE DATA CENTER AND INFRASTRUCTURE ENGINEERING
EDICT
ENTERPRISE DATA CENTER INFRASTRUCTURE COLLABORATION TEAM

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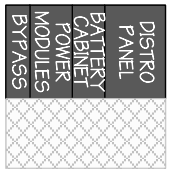
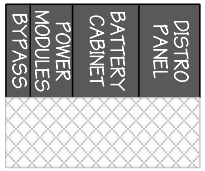
TYPICAL RACK AND ZONE PDUS

EATON 93PM (93PM-L FOR 208 V MODEL)



- CLEARANCE
  - FRONT: 36 IN.
  - BACK (TOP EXHAUST): 0 IN.
  - BACK (REAR EXHAUST): 10 IN.
- BATTERY CABINET
  - 16.7 IN. FOR SMALL
  - 34.2 IN. FOR LARGE
- DISTRIBUTION PANEL

31.3 IN.



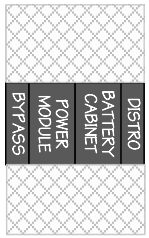
- BYPASS
  - 14.69 IN. FOR 480 V
  - 12.45 IN. FOR 208 V
- POWER MODULES
  - 480 V
    - 30-150 KW – 22 IN.
    - 160-200 KW – 32 IN.
  - 208 V
    - 10-120 KW – 22 IN.
    - 10-160 KW – 34.4 IN.

10-200 KW – 43.3 IN

10-200 KW MODULAR UPS
FRAME COMMENSURATE WITH COMPUTER ROOM ULTIMATE CAPACITY; POWER MODULES BUILT OUT TO N+1 INTERNAL REDUNDANCY BASED ON CRITICAL LOAD
ONLY REQUIRES FRONT CLEARANCE

3 MODULAR UPS OPTION FOR COMPUTER ROOMS

APC SYMMETRA PX 10-100



- CLEARANCE
  - FRONT: 36 IN.
  - REAR: 40 IN.
- BATTERY CABINET
  - 23.62 IN.
- DISTRIBUTION PANEL
  - 11.8 IN.
- BYPASS
  - 11.8 IN.
- POWER MODULES

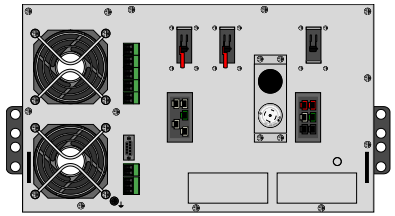
23.62 IN.

10-100 KW MODULAR UPS
FRAME COMMENSURATE WITH COMPUTER ROOM ULTIMATE CAPACITY; POWER MODULES BUILT OUT TO N+1 INTERNAL REDUNDANCY BASED ON CRITICAL LOAD
REQUIRES FRONT AND REAR CLEARANCE

4 MODULAR UPS OPTION SFOR COMPUTER ROOMS

RACK MOUNT UPS. L5-30 INPUT. L5-30 OUTPUT.
CAPACITY NTE 2880 VA. 2 RU. METERED
(APC SMX3000RMLV2U OR EQUIVALENT)

2 RACK-MOUNT 2.88 KW UPS FOR TES



RACK MOUNT UPS.
CAPACITY: 5 KW (EXTERNAL BATTERY MODULES AVAILABLE)
INPUT VOLTAGE: 208 V
INPUT CONNECTION: L21-20P, THREE-PHASE, FOUR-WIRE + GROUND
OUTPUT CONNECTION: L21-20R
SIZE: 6 RU, 19 IN. RACK-MOUNTABLE
RUNTIME: 16.5 MINUTES AT 50% LOAD
(EATON BLADEUPS ZC0517700110000
OR EQUIVALENT)

1 RACK-MOUNT 5 KW UPS FOR TRS AND ENTRANCE ROOMS

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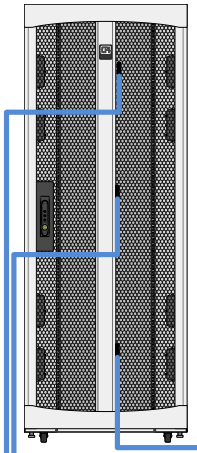
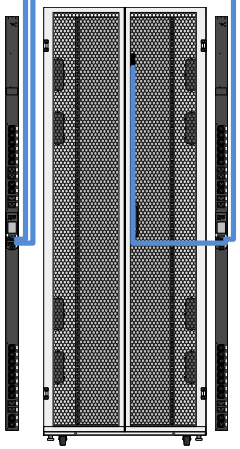
TYPICAL UPSS

FRONT OF RACK



BACK OF RACK



2 TEMPERATURE AND HUMIDITY SENSOR LOCATIONS AND CONNECTIONS

CHATSWORTH 14665-001
USB TEMPERATURE AND
HUMIDITY SENSOR (OR
EQUIVALENT)

1 TEMPERATURE AND HUMIDITY SENSOR

DEPARTMENT OF VETERANS AFFAIRS

OFFICE OF INFORMATION AND TECHNOLOGY

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SHEET TITLE

TYPICAL TEMPERATURE AND HUMIDITY MONITORING

Data Center Cabinet Outfitting

EDICT Quality Assurance (QA) Job Aid

June 18, 2025

The Data Center and Infrastructure Engineering Team (DCIE) and Enterprise Data Center Infrastructure Collaboration Team (EDICT) Technical Working Group (TWG) have developed this guidance as a supplementary narrative to the VA Infrastructure Standard for Telecommunications Spaces to provide additional detail for field Office of Information and Technology (OIT) and Facilities Management Service (FMS) staff, architects/engineers (A/Es), and implementing contractors and Department of Veterans Affairs (VA) staff. Please contact EDICT@va.gov for additional information.

Executive Summary

EDICT's Quality Assurance (QA) efforts have repeatedly found a lack of standardized guidance for properly installing power distribution and preparing Information Technology Equipment (ITE) racks and cabinets in the VA environment. This technical brief offers detailed instructions to contractors on correct and incorrect installation practices and guidance to the OIT and FMS staff in the field responsible for inspecting and accepting contractor-provided construction solutions.

Prior to the installation of IT equipment, both network cabinets and server cabinets must be properly set up. Network and server cabinets in VA telecommunications spaces must be inspected and accepted (formally turned over) from the Contractor to VA prior to being available for VA use.

This Quality Assurance (QA) document provides visual guidance on what to look for in each type of cabinet during an inspection prior to acceptance, either at the substantial completion of a project or for partial beneficial occupancy. A checklist at the end of the document may be used in support of acceptance inspections.

This document contains no VA-proprietary information and may be distributed to designers, general contractors, and low-voltage subcontractors without restriction.

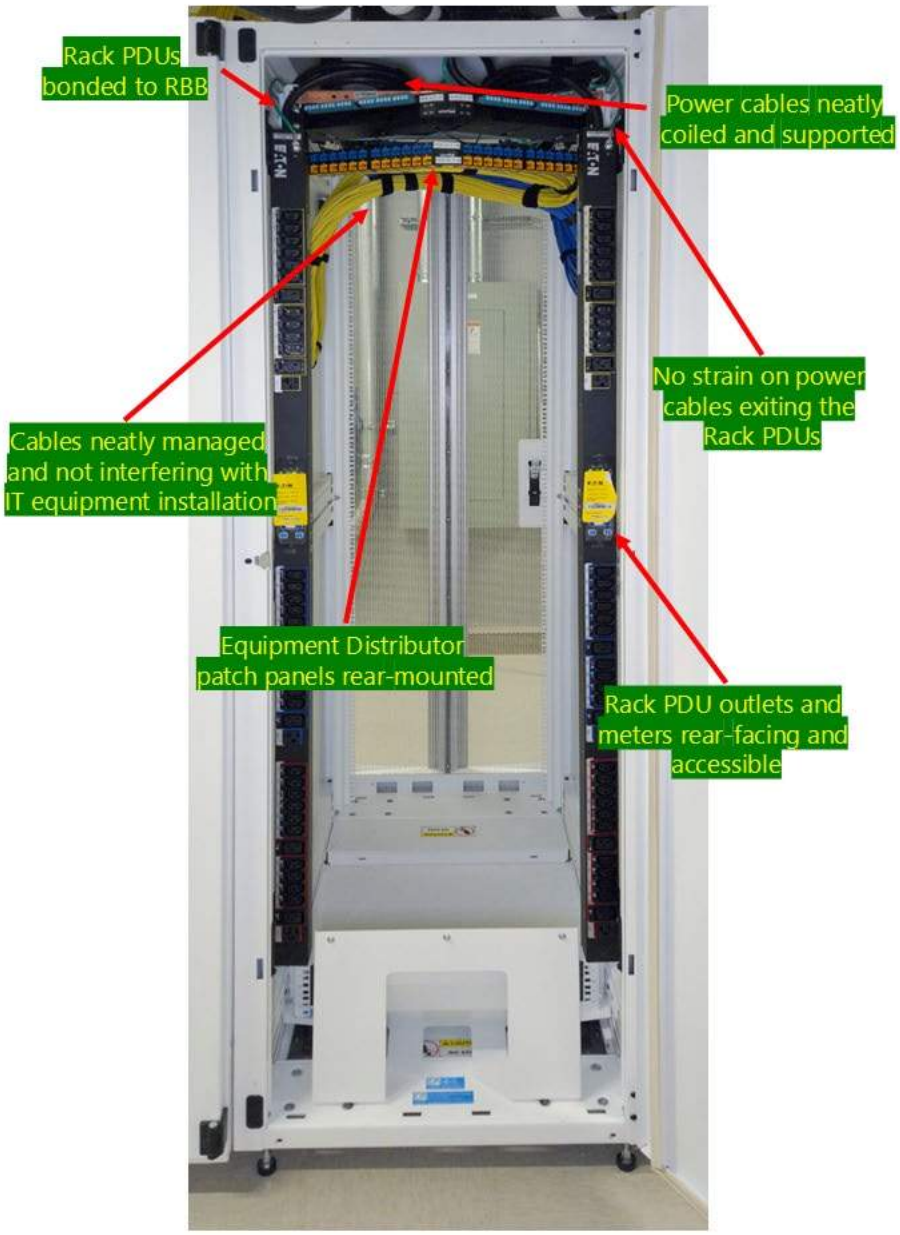

Figure 1. Ideal Server Cabinet Outfitting Example, Rear View with Doors Open.

The ideal 24" server cabinet layout can only be achieved prior to IT equipment beginning to be installed. The most critical areas for inspection are (a) Equipment Distributor location facing the rear of the rack, (b) rack rail positioning (shown in more detail in later figures), (c) telecommunications cabling management and support, and (d) proper Rack PDU and power cord management.

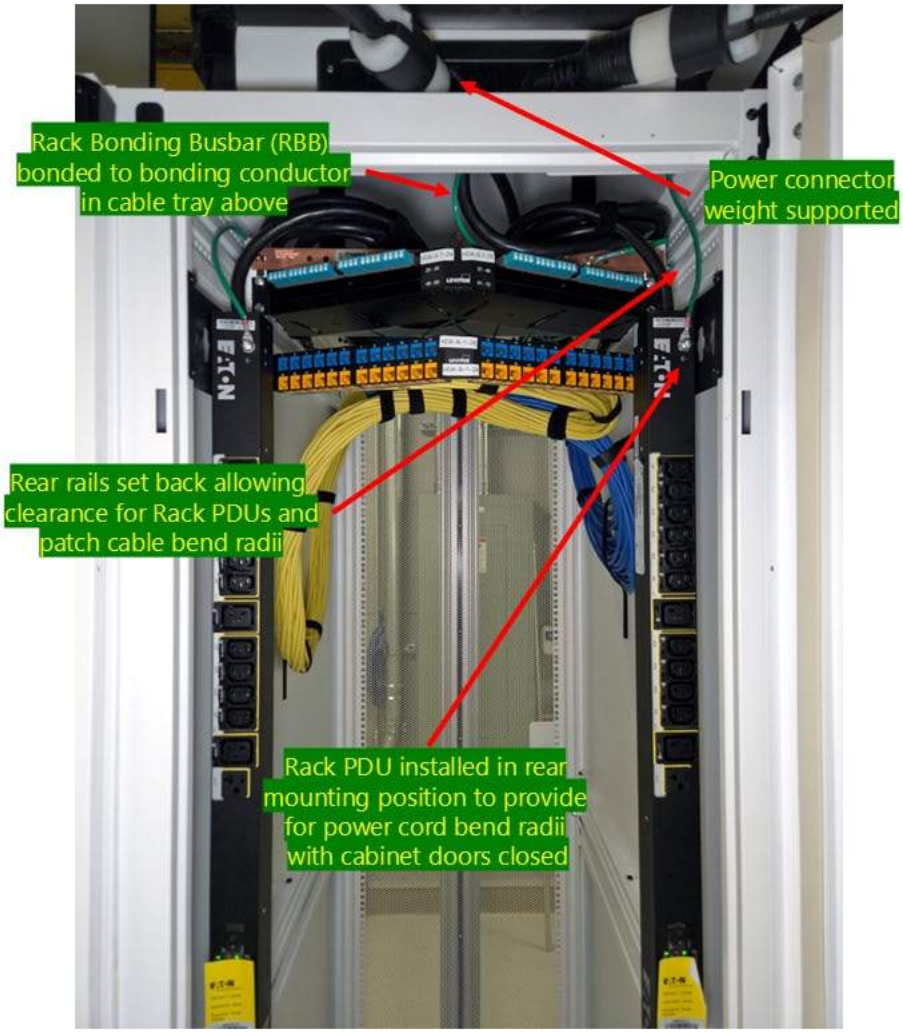

Figure 2. Enhanced Detail of Ideal Server Cabinet Outfitting.

Attention to detail across the board will necessarily result in an aesthetic, sustainable, and maintainable installation that will be able to support multiple generations of IT equipment with minimal work involved in future Moves, Adds, and Changes (MACs). Note that Rack Bonding Busbars (RBBs) are not mandatory accessories in server cabinets.

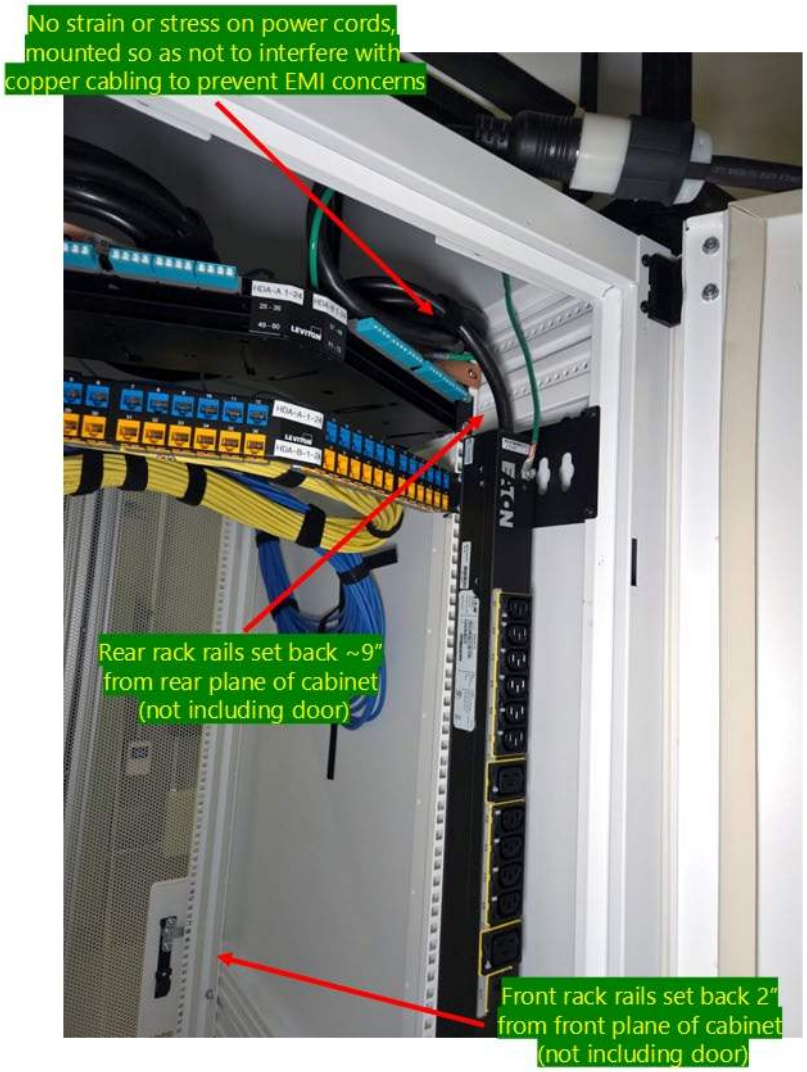

Figure 3. Isometric Detail View of Ideal Server Cabinet Outfitting.

Front and rear rack rails will need to be relocated from their shipping position to accommodate VA's equipment outfitting. The front rail should be located approximately 2" recessed from the front plane of the cabinet, and the rear rail recessed approximately 9" from the rear plane of the cabinet. This provides the necessary physical space to install Rack PDUs, equipment power cords, and patch cabling to IT equipment without exceeding cabling bend radii.

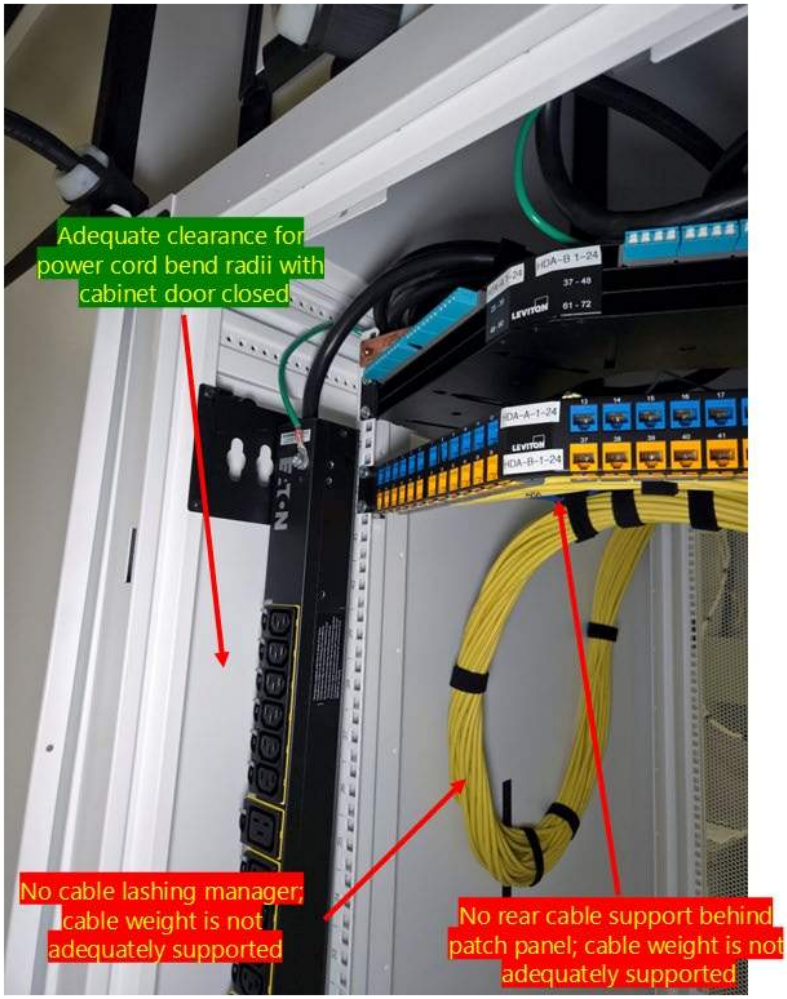

Figure 4. Structured Cabling Support to Equipment Distributors.

Cable lashing managers located between the cabinet sidewalls and the 19" rack rails are necessary to effectively support the weight of structured cabling, even in the server cabinets. This figure shows an attempt at an alternative approach that does not provide sufficient support for the mass and weight of the cabling. In addition, strain relief for the cables at their termination point on the patch panels has not been provided. 19" rear cable support bars should have been used.

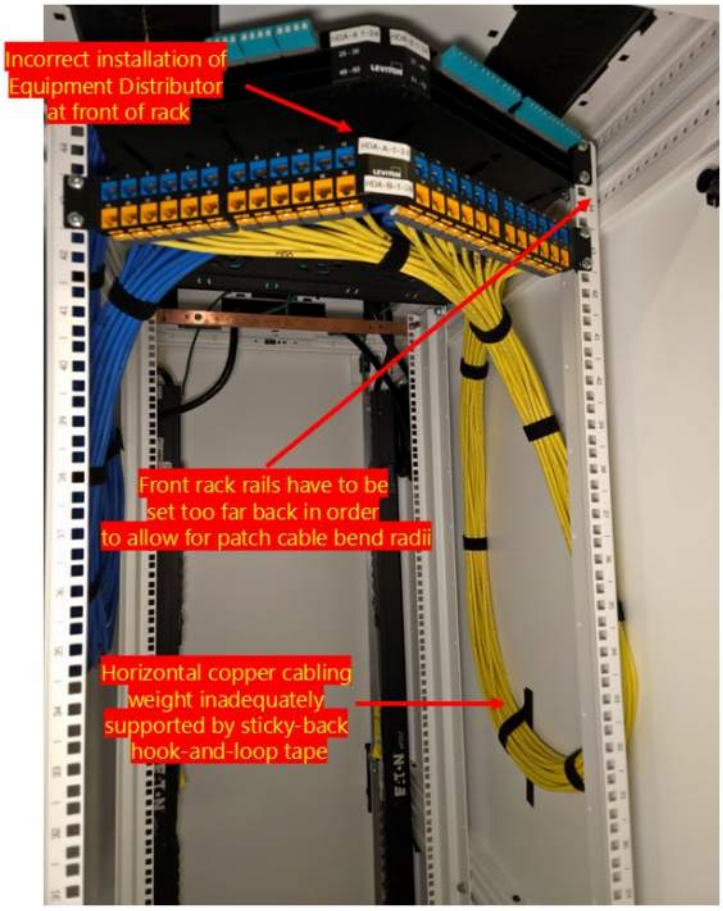

Figure 5. Why Equipment Distributors Cannot Be Front-Mounted.

Front-mounting Equipment Distributors in server cabinets is not permitted. They are designed to be rear-mounted so that patch cables run the shortest length possible to the Network Interface Cards (NICs) in the rear of IT equipment, without having to pass through the blanking panel airflow barrier at the front plane of the server cabinet. Front-mounting also requires the front rack rails to be positioned farther back from the front plane of the cabinet, which restricts the depth of IT equipment that can be installed due to equipment rail mounting to the rack rails.

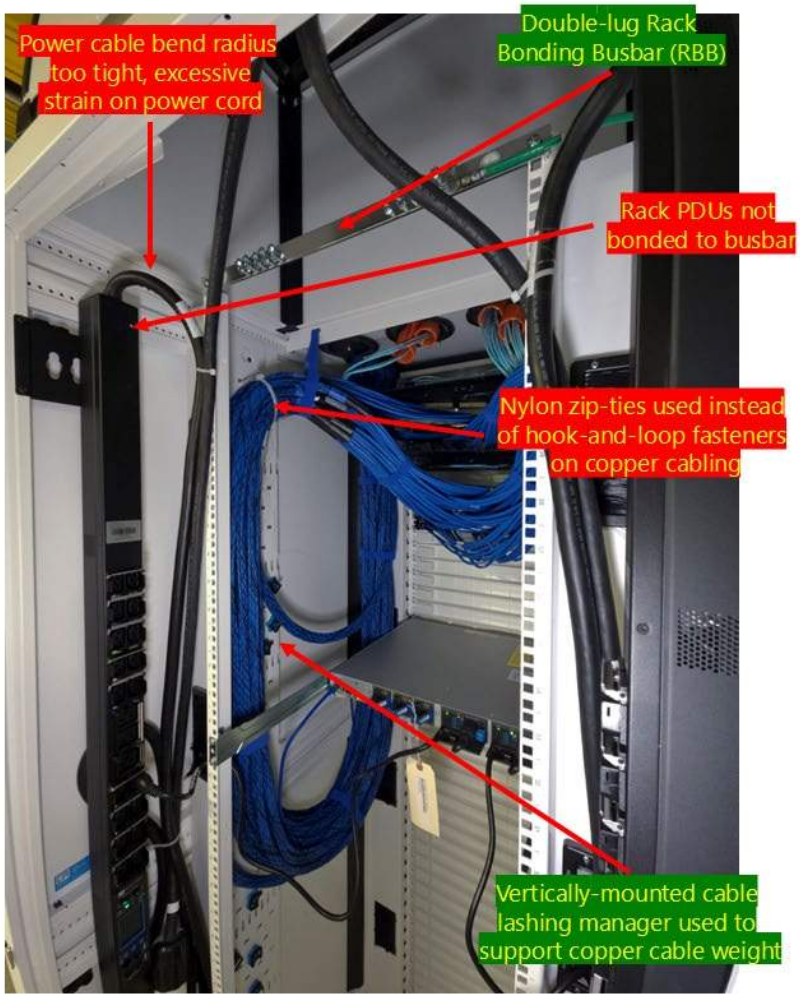

Figure 6. Interior View of Network Cabinet Outfitting.

Network cabinets may be wider than server cabinets, or may be supplied with sidecars for cable management. In previous figures the Rack PDUs were shown (ideally) facing to the rear; some Rack PDUs are only designed to be hung from bolts on their back sides, however, and will either have to face in to the center as shown here, or mounting hardware allowing them to be rear-facing procured (not typically a standard item). Aim to minimize the potential for interference between power cords and patch cords.

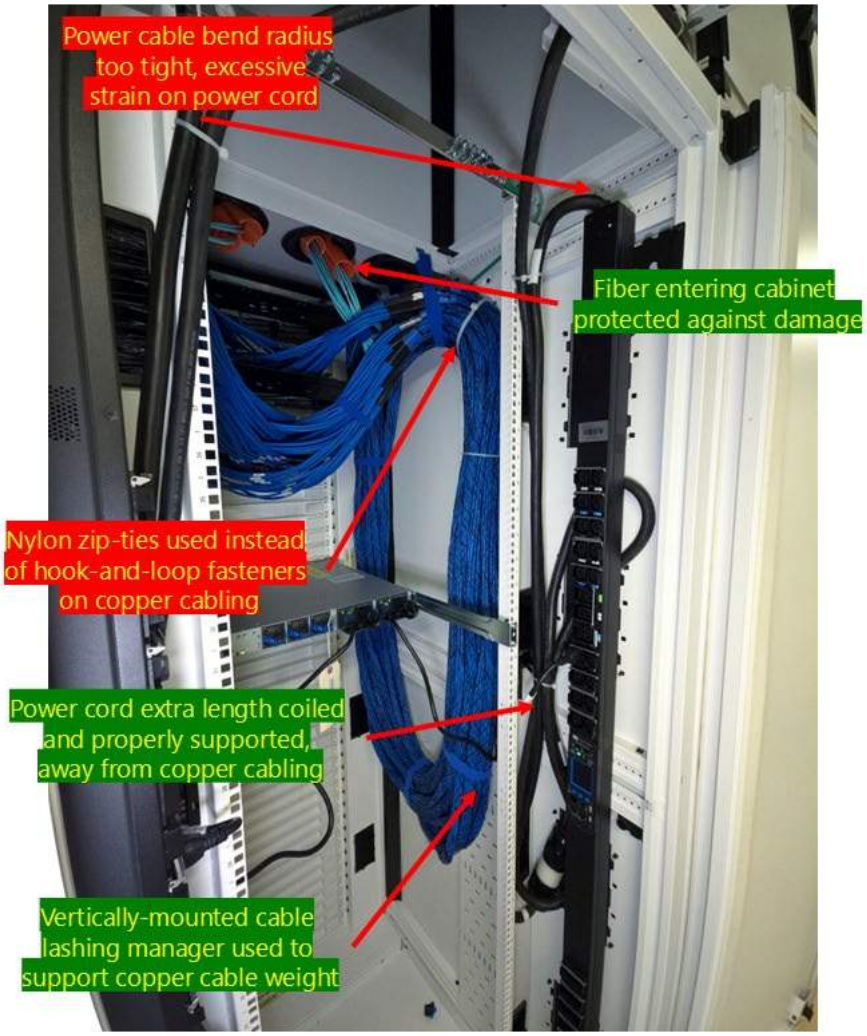

Figure 7. Interior View of Network Cabinet Outfitting.

Look carefully at the details of power cord support and stowage from the electrical distribution busway tap box to the inlet to the PDU. Is the installation clean and sustainable, not likely to impact other systems over the lifecycle of the data center, and aesthetic? If improvements can be made to the workmanship interior to the cabinets prior to acceptance, have them made.

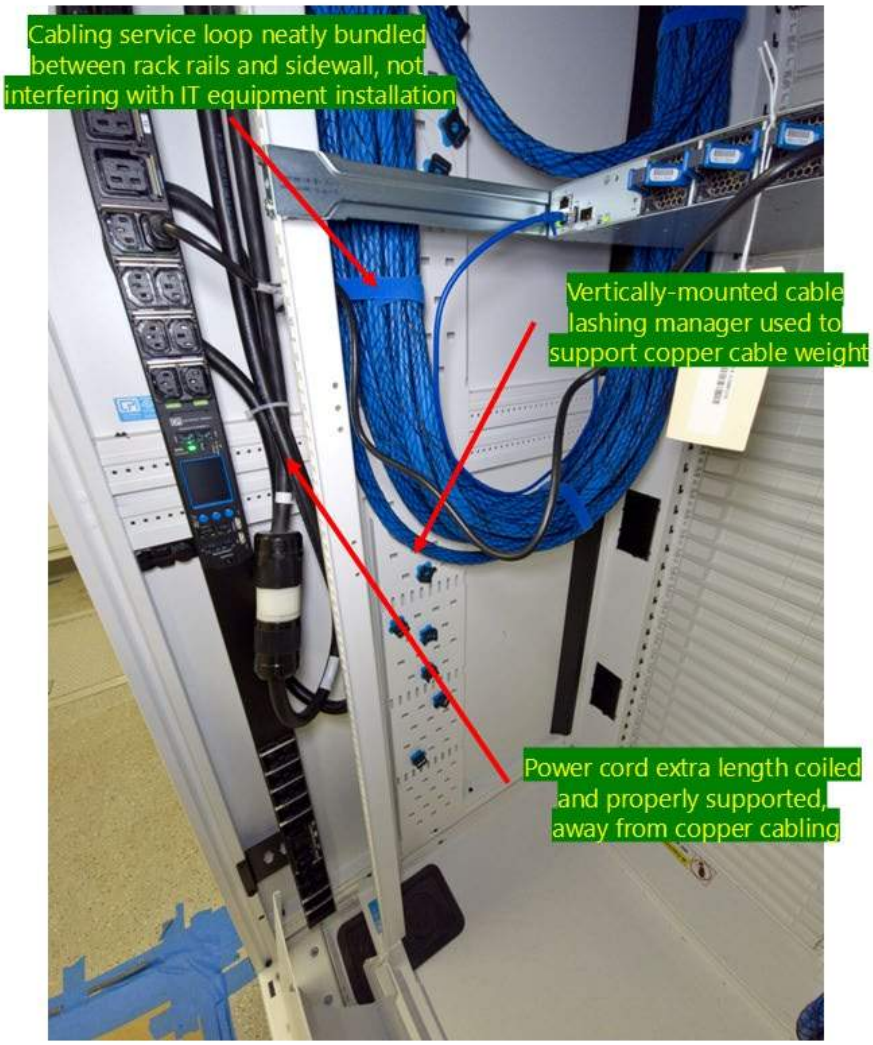

Figure 8. Interior View of Network Cabinet Outfitting.

This figure shows excellent separation between power elements and copper structured cabling, preventing EMI risks, and good use of a vertical cable lashing manager to support the large amount of copper cabling. Both vertical and horizontal cable lashing managers are available, and should be utilized in both network cabinets and server cabinets.

Network & Server Cabinet Acceptance Inspection Checklist

Purpose: Quality Assurance (QA) job aid to allow Government representatives to conduct pre-acceptance inspections on IT equipment enclosures. Use is voluntary but suggested to ensure delivery of acceptable quality installations prior to Government acceptance/occupancy and IT equipment migrations.

Assigned: Project Engineer/COR and OIT Representative

Instructions: Following new construction, modification, and equipment migration, spot-check the required elements below according to ISTS requirements. Provide the inspection date at the bottom of the checklist.

	Inspection Item	Y	N	N/A
Architectural	Space is clean and clear of all trash and excess equipment. Interior of cabinets have been cleaned of construction debris and dust.			
	(Server Cabinets) Equipment Distributor mounted to rear rack rails. Rear rack rails recessed ~9" from rear plane. Adequate space for patch cable bend radii with rear door closed. Front rack rails recessed ~2" from front plane.			
	(Network Cabinets) Patching fields mounted to front rack rails. Front rack rails recessed ~9" from front plane.			
	Cabinet mounting rails not blocked or used to support non-IT equipment.			
	All equipment, cables, and power distribution labeled per ISTS standards.			
Telecom	100% passing test results for all structured cabling delivered to COR.			
	Structured cabling enters/exits wire basket cable tray through waterfall transitions.			
	Cabling service loops inside cabinets supported with cable lashing managers and rear cable bars. Strain on cabling connections is relieved by proper lashing support. Cabling does not interfere with installation of IT equipment to rack rails.			
	Rack Bonding Busbars (RBBs) installed in network cabinets. All racks/cabinets bonded to the main bonding conductor.			
	Angled copper and fiber patch panels used for the structured cabling system.			
Electrical	Power and network cable management in rear of cabinets neat and professional. Hook and loop cable management straps used; no zip ties on telecommunications cabling.			
	Armored fiber (where used) properly bonded to the RBB.			
	Power cabling supported and strain relief provided; no tight bend radii entering Rack PDUs. Excess power cord neatly coiled and lashed, away from copper telecom cabling.			
	Rack PDUs properly mounted on left and right rear of cabinets. Outlets and monitors are accessible to technicians. Power cord installation will not unduly interfere with IT equipment or patch cabling use.			
Mechanical	Rack temperature sensors installed (typically connected through Rack PDUs).			
	Blanking panels installed in every open RU position on front of cabinets. Air dams installed around perimeter of rack rails in network cabinets. No bypass airflow possibilities.			

Questions can be directed to OITDataCenterEngineering@va.gov. **Date Inspected:**

Figures

Figure 1. Ideal Server Cabinet Outfitting Example, Rear View with Doors Open. 2
Figure 2. Enhanced Detail of Ideal Server Cabinet Outfitting. 3
Figure 3. Isometric Detail View of Ideal Server Cabinet Outfitting. 4
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Figure 5. Why Equipment Distributors Cannot Be Front-Mounted. 6
Figure 6. Interior View of Network Cabinet Outfitting. 7
Figure 7. Interior View of Network Cabinet Outfitting. 8
Figure 8. Interior View of Network Cabinet Outfitting. 9

References

- VA Infrastructure Standard for Telecommunications Spaces
- VA IT Equipment Compatibility Standard
- VA PG-18-12 Telecommunications Design Guide
- EDICT Technical Brief 25-11: Beneficial Occupancy in Telecommunications Construction Projects

Change Register

Table 1: Change Register

Date	Description of Change
6/18/2025	Document Created

Rack Operations Preparation & Power Distribution Guidance

EDICT Quality Assurance (QA) Job Aid

April 9, 2025

The Data Center and Infrastructure Engineering Team (DCIE) and Enterprise Data Center Infrastructure Collaboration Team (EDICT) Technical Working Group (TWG) have developed this guidance as a supplementary narrative to the VA Infrastructure Standard for Telecommunications Spaces to provide additional detail for field Office of Information and Technology (OIT) and Facilities Management Service (FMS) staff, architects/engineers (A/Es), and implementing contractors and Department of Veterans Affairs (VA) staff. Please contact EDICT@va.gov for additional information.

Executive Summary

EDICT's Quality Assurance (QA) efforts have repeatedly found a lack of standardized guidance for properly installing power distribution and preparing Information Technology Equipment (ITE) racks and cabinets in the VA environment. This technical brief offers detailed instructions to contractors on correct and incorrect installation practices and guidance to the OIT and FMS staff in the field responsible for inspecting and accepting contractor-provided construction solutions.

Telecommunications, Electrical, Architectural, and Mechanical (TEAM) Intent for the Rack or Cabinet

The architectural intent of the rack or cabinet in both the data center and telecommunications room environments is to physically support passive and active ITE. This is done by mounting the equipment to the rack rails in specified Rack Unit (RU) positions, on the front and rear of the rack or cabinet based on standard VA design guidance. This is the only authorized use of the RU mounting positions on rack or cabinet rails.

The mechanical intent of the network or server cabinet in the VA data center environment is to strategically allow for complete supply (inlet, cold) and return (exhaust, hot) airstream separation for the environmental control system. Supply air is conditioned air that is provided at the front of the cabinet where the ITE inlets are located. Exhausted air is returned directly to the data center air conditioning units by return air ducting or other containment systems, which prevents intermixing of the two airstreams. There is no mechanical strategy for racks used in the telecommunications room (TR) environment as this application will not prevent intermixing.

The electrical intent for the cabinet/rack application in both the data center and telecommunications room (TR) environments is to provide power distribution to the active ITE that will be installed inside only in that enclosure. This approach will minimize impacts to technician access to the rear of the ITE equipment and also minimize the risk of inadvertent power cord/cable disconnection of interfacing infrastructure.

The telecommunications intent for the cabinets/racks differs depending on the type of space and the use of the data center cabinets (Main Distribution Area, Horizontal Distribution Area, or server cabinet). In all of these, the primary intention is the physical protection of telecommunications media and connectors from inadvertent damage or disconnection to eliminate loss of connectivity and ensure system resiliency.

Preparing Racks & Cabinets for IT Equipment Installation

Once racks and cabinets are installed as indicated in the design drawings, ensure that the applicable 36" clearances in both front and rear allowing for appropriate access to ITE is maintained. The associated accessories are to be installed in a manner to make the racks/cabinets fully functional and vertical rack rails must be positioned properly to allow installation of the passive and active ITE The vertical rack rails can be identified by the square mounting holes and printed RU numbers. (The rack rails on network channel racks used in the telecommunications rooms are part of the structure and are not adjustable.)

Figure 1. Example of Adjustable Rack Rail with Square Hole Mounting.

The rack rails typically come pre-installed as far forward and as far to the rear as possible as preset locations. These rail positions are considered to be adjustable, and generally require relocation to allow for proper equipment installation. These rack rails must be properly positioned prior to terminating structured cabling to patch panels or

installing ITE in the cabinets. Doing so will reduce the potential for dropped objects, prevent inadvertent disconnection, and ensure the integrity of related cords, cables, and connections. All ITE installed in cabinets must be installed and maintained in a manner to allow the cabinet door to open, close, and latch without obstruction.

In network cabinet (MDA and HDA) installations, if the rack rails are not positioned properly, telecommunications patch cables will be damaged when the doors of the cabinet are closed. In general, a minimum 3" of clearance between the front plane of the patching equipment and the front plane of the cabinet (not including the front door assembly) is needed to ensure that all cable minimum bend radii can be met. Note that this does not translate to setting the rack rails back 3", as shown in the figure below.

Figure 2. Network Cabinets with Patching Equipment Front-Mounted. (a) Result of Improper Rail Position on Patch Cables. (b) This Is Despite the Front Rails Being Set Back Several Inches. (c) Proper Clearances for Patch Cables Achieved by Greater Setback.

Note that in server cabinets all network connections and patching equipment is specified to be in the rear of the enclosure. The front rails for server cabinets should be set back a minimum of one inch and a maximum of two inches from the front plane of the enclosure (not including the front door assembly).

Processes for making rack rail adjustments will vary by the specific cabinet.

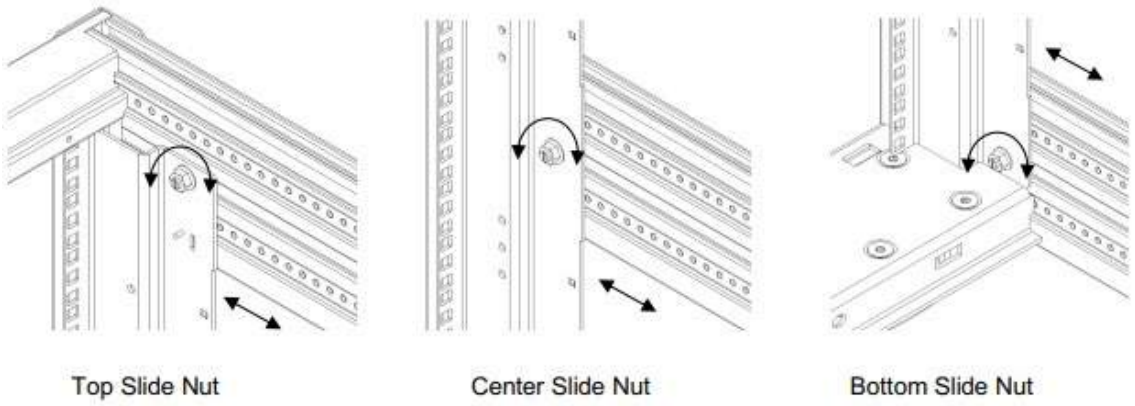

Figure 3. Example of How to Make Rack Rail Adjustments (may vary by manufacturer).

Rack & Cabinet Accessories and Outfitting

Network and server cabinets used in the VA data center environment will generally require the installation and use of a variety of accessories and equipment to meet the electrical, telecommunications, and mechanical intent of VA's designs. Specific accessory requirements will vary based on the make/manufacturer/model of cabinet used; this guidance is generic and will need to be implemented by the installing contractor based on the specifics of the cabinet equipment used.

When building out a data center whether a new construction, a legacy modernization, performing Move/Add/Change (MAC) work, or typical Operations & Maintenance (O&M), the accessories and equipment discussed are always the financial responsibility (unless otherwise specifically indicated) of the low voltage subcontractor to procure and properly install in a neat and workmanlike manner.

Patch Panel Installation Locations

In data center network cabinets (MDAs and HDAs) and in telecommunications room network racks, patch panel equipment (both copper and fiber) is installed on the front side of the enclosures. In data center server cabinets, patch panel equipment is installed on the rear side of the cabinets – where the rear of the IT equipment provides direct access to the network interface cards (NICs).

When installing the patch panel equipment, ensure that clearances between the equipment and the front plane of the enclosure are sufficient to not impede door closure or risk damaging installed patch cables, as described in the previous section.

Air Dams, Blanking Panels, & Vertical Exhaust Ducts (VEDs)

These items are not required in network racks in the telecommunications room environment.

In the data center environment, it is critical to minimize bypass airflow, which is cold supply air being returned to the air conditioning system without having fulfilled its purpose – absorbing heat from the operating IT equipment in the room. Install air dams around the perimeter of the rack rails and frame of cabinets to prevent air from flowing around IT equipment and being sent directly into the return air pathway. Install 1 RU blanking panels in every open RU on the front side of every cabinet in the data center not occupied by ITE.

Solid Rear Doors

If the data center mechanical/heat rejection system uses VEDs to force air upward into a return duct or plenum, perforated rear doors on the cabinet will need to be replaced with solid doors to prevent or reduce return air loss and intermixing with conditioned supply air.

Network Cabinet Interconnection Pathways

The Main Distribution Area (MDA) network cabinets in the data center will be adjacent to one another, either in one long set (both A and B sides) or in two short sets (A and B separated). Adjacent MDA cabinets require internal pathways to pass patch cabling between the cabinets, without exiting the enclosures.

In order to achieve this, install cabinet side panels with brushed grommet passages for this purpose on these cabinets. If solid side panels were provided, holes must be cut in these using a 4" knockout kit and brushed grommets installed through the sidewalls of both adjacent cabinets.

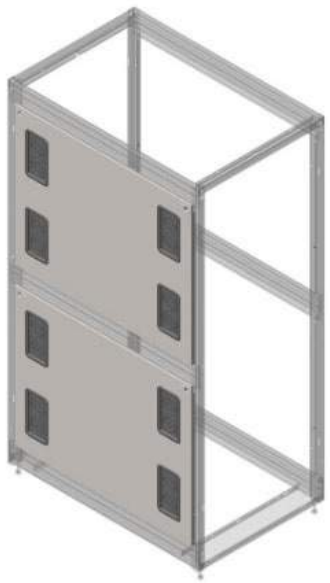

Figure 4. Manufacturer's Example of Grommeted Side Panels.

Cable Lashing Managers

The cable lashing managers provide strain relief and support for structured cabling interior to data center network cabinets. They are required to be provided and used in the MDA and HDA cabinets where campus fiber and copper backbone and data center structured cabling systems are to be installed. Lashing managers are not needed in data center server cabinets nor in the network channel racks in telecommunications rooms.

Figure 5. (a) Example of Structured Cabling Installed Without Supporting Strain Relief. (b) Example Cable Lashing Manager. (c) Example of Structured Cabling Properly Installed With Supporting Strain Relief.

PDU Mounting Brackets

PDU mounting brackets allow the vertical Rack Power Distribution Units (PDUs) to be mounted to the rack or cabinet in a "zero-U manner", which will not take up any of the space reserved for ITE, while also minimizing the amount of space needed to distribute electrical power in the rear of the enclosures.

Figure 6. Example of Dual Rack PDU Bracket Installation (for High Density Server Cabinet) with Rack Rails Relocated.

Brackets are specific to the type of enclosure and PDU selected, and to how the vertical Rack PDUs are intended to be mounted. The next section provides additional detail on mounting practices that will inform the bracket selection.

Ensure that only the proper mounting brackets and associated installation equipment are used, which are installed in the proper locations per manufacturer's instructions for power distribution equipment to prevent the inability to properly install ITE.

Installation of Vertical Rack PDUs in IT Equipment Racks & Cabinets

Vertical Rack Power Distribution Units (PDUs) are specified as being zero-U mounted, meaning that they do not improperly take up Rack Unit (RU) space in the racks or cabinets. The necessary brackets and other equipment necessary to mount these will be specific to the type of enclosure and the PDU which are selected.

Proper Rack PDU orientation is critical to reducing congestion caused by power cords. Use equipment with the appropriate length power cords (i.e., 3', 6', 10', etc.) for the installation location and how excess length of the cords will be coiled into service loops and supported for strain relief; aftermarket Kellem's Grips may be installed to assist in supporting cable weight. Mounting excess length over the top of the enclosure is preferred, ensuring that this mounting does not cause an increased risk of electromagnetic interference (EMI) with telecommunications cabling.

Rack PDU Mounting in Server Cabinets

Mounting Rack PDUs in server cabinets is standardized. Rack PDUs are mounted internal to the cabinet, the A side PDU(s) on the left, and the B side PDU(s) on the right, when viewed from the rear side/return air side of the cabinet. Color-differentiated Rack PDUs are preferred, aligning with the requirement for color-differentiated locking power cords indicating redundant A & B power source feeds. Per the VA Infrastructure Standard for Telecommunications Spaces (ISTS), the A side should be black and the B side another distinguishable color.

Mount the Rack PDUs against the sidewalls at the very rear of the cabinet, using the appropriate brackets, mounting, or installation configuration, so that the A and B PDU outlets face the rear (preferred) or towards the center of the cabinet and the metering display is readily and easily accessible and visible to a technician. Do not block access to the rack rails, which may have to be relocated forward to remain accessible.

Figure 7. (a) Example of Dual Rack PDU Installation (for High Density Server Cabinet). (b) Detail of Rack PDU Properly Mounted in a Server Cabinet (inside of the cabinet, looking to the rear).

Rack PDU Mounting in Computer Room Network Cabinets

Beginning in version 5 of the VA Infrastructure Standard for Telecommunications Spaces (ISTS) vertical cable managers in both the front and rear of network racks or full-depth sidecars are required for network cabinets to ensure a mounting location for the Rack PDUs is provided. As shown in the discussion and diagrams below, this presents the least intrusive mounting method, while preserving the rear opening of the rack for technician access.

Rack PDUs in network cabinets may be mounted as described for server cabinets or in the rear of sidecars used as vertical cable managers.

Rack PDU Mounting in Telecommunications Room Network Racks

Beginning in version 5 of the VA Infrastructure Standard for Telecommunications Spaces (ISTS) vertical cable managers in both the front and rear of network racks or full-depth sidecars are required for network cabinets to provide a mounting location for the Rack

PDUs. As shown in the discussion and diagrams below, this presents the least intrusive mounting method and preserves the rear opening of the rack for technician access.

The optimal approach for Rack PDU mounting is shown in the diagrams below. In order to mount Rack PDUs in the rear vertical cable managers (VCMs) shown, the middle VCM must be at least a 10-inch VCM instead of the 6-inch typically specified. When using 6" VCMs, the space between the racks is 2.5"; when using the 10" VCMs, the space between racks is 6.5", sufficient to fit the two Rack PDUs side-by-side.

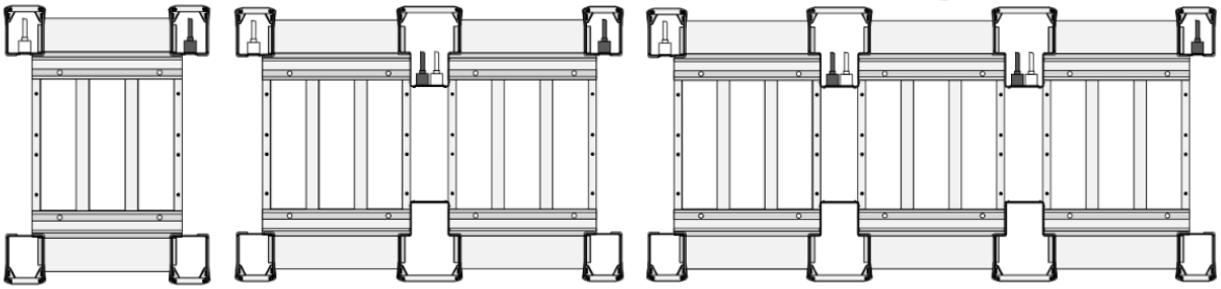

Figure 8. Optimal Rack PDU Positioning Using Rear Vertical Cable Managers (One, Two, & Three Rack Installations Shown).

Note: EDICT is aware that the use of 10" VCMs reduces the available clear width in a standard sized Telecommunications Room. Continue to maintain a minimum of 36" clearance on at least one side of the row of racks.

Rack PDU installation must not present conflicts with other functions of the network racks and installed equipment. Examples of unacceptable conflicts include installing such that the Rack PDUs are inaccessible, where power cords block access to the IT equipment and/or rack rails, opening/closing of cabinet doors, and where installation blocks IT equipment from utilizing the rear rack rails.

Regardless of whether 10" VCMs are utilized, Rack PDUs should be installed facing the rear of the racks in the Telecommunications Room environment. Provide the appropriate brackets to mount in this orientation in all situations.

In existing environments, Rack PDU mounting locations can be limited and may not provide the capability to be optimized. Here are several options are presented to guide bracket selection and mounting.

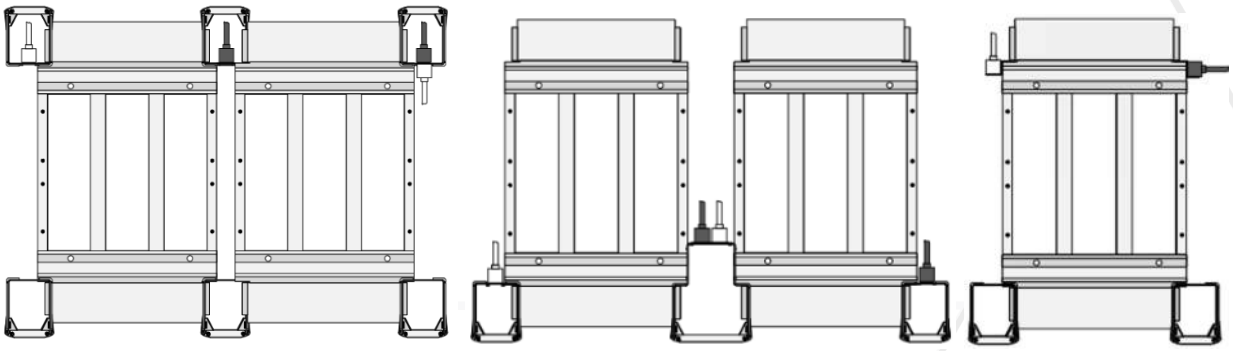

Figure 9. Rack PDU Mounting Options for Legacy & Existing Telecommunications Rooms.

Note that in the first example in the figure above the brackets may need to be staggered in height for Rack PDUs to be front-and-rear mounted as shown.

Quality Assurance (QA) Examples of Rack PDU and Power Installations

This section provides graphic guidance on acceptable and unacceptable installations, describes why each example is good or bad, and provides guidance on remediations required.

Figure 10. Quality Assurance Example. Rack Rails Used Inappropriately.

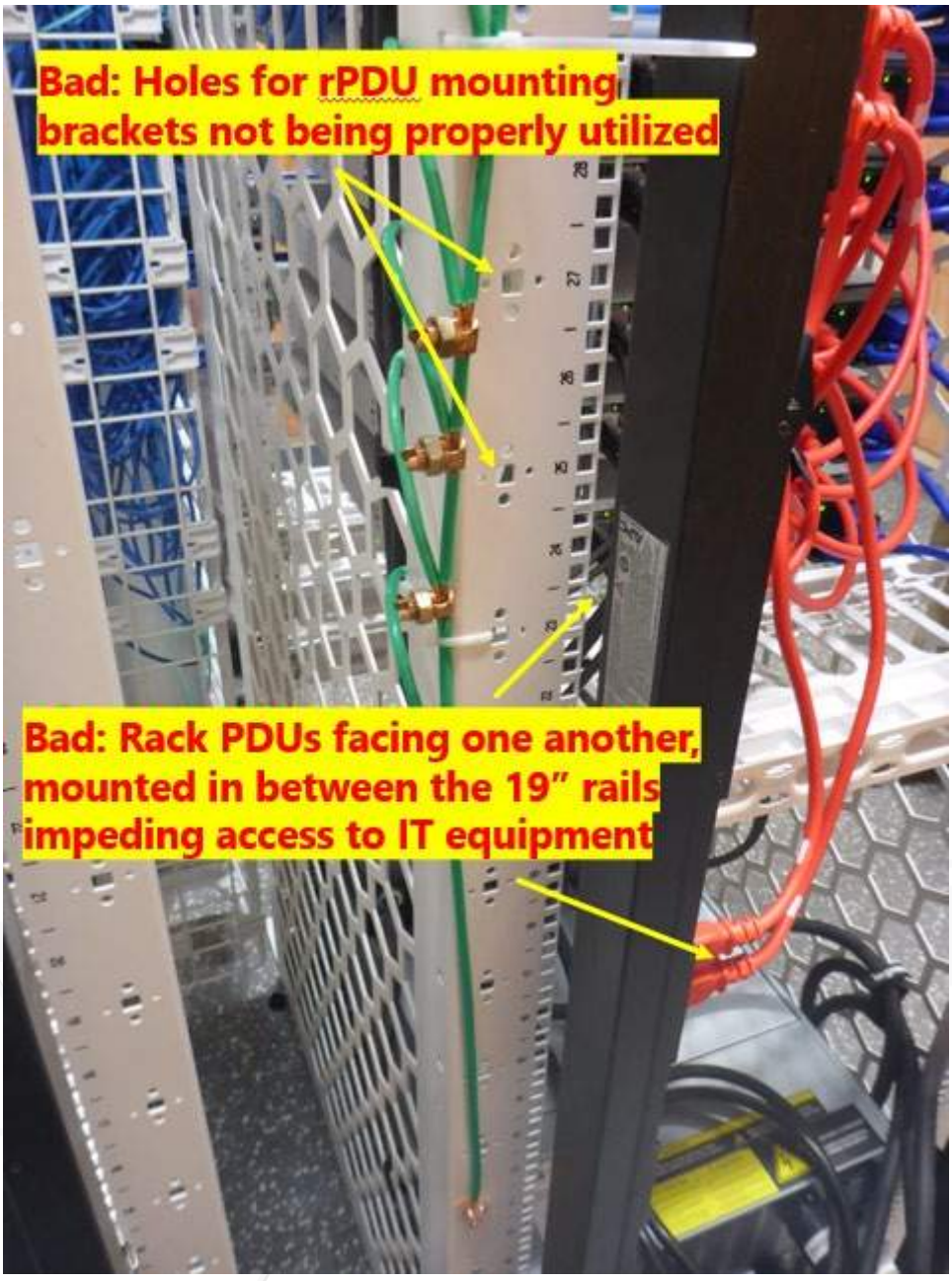

Figure 11. Quality Assurance Example. Rack PDUs Block IT Equipment Access.

Figure 12. Quality Assurance Example. Power Cable Management.

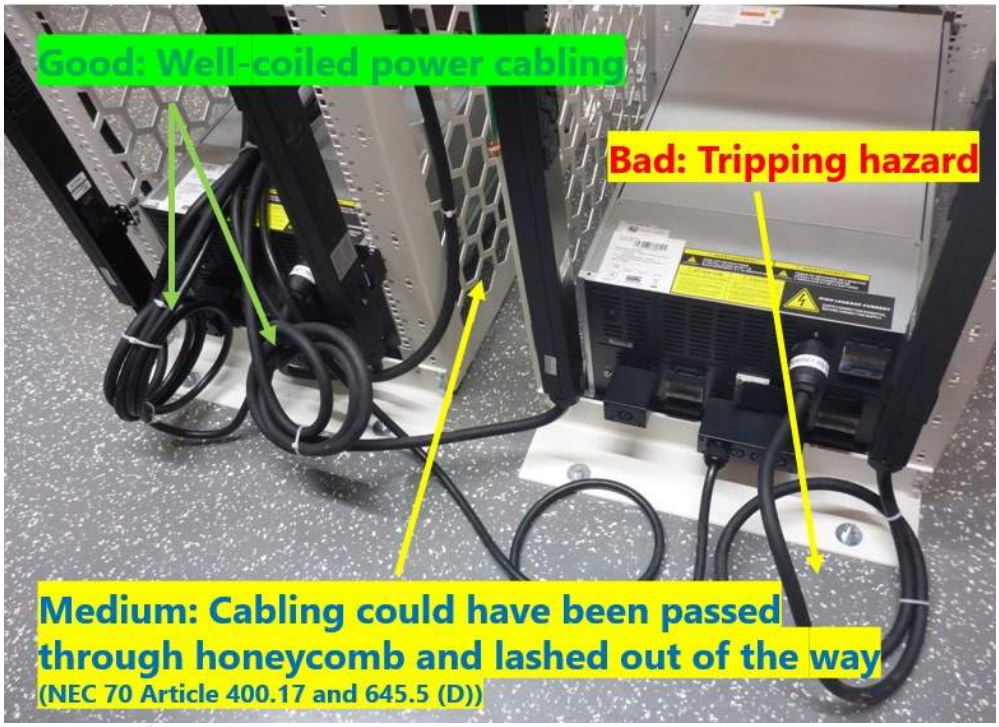

Figure 13. Quality Assurance Example. Power Cable Management.

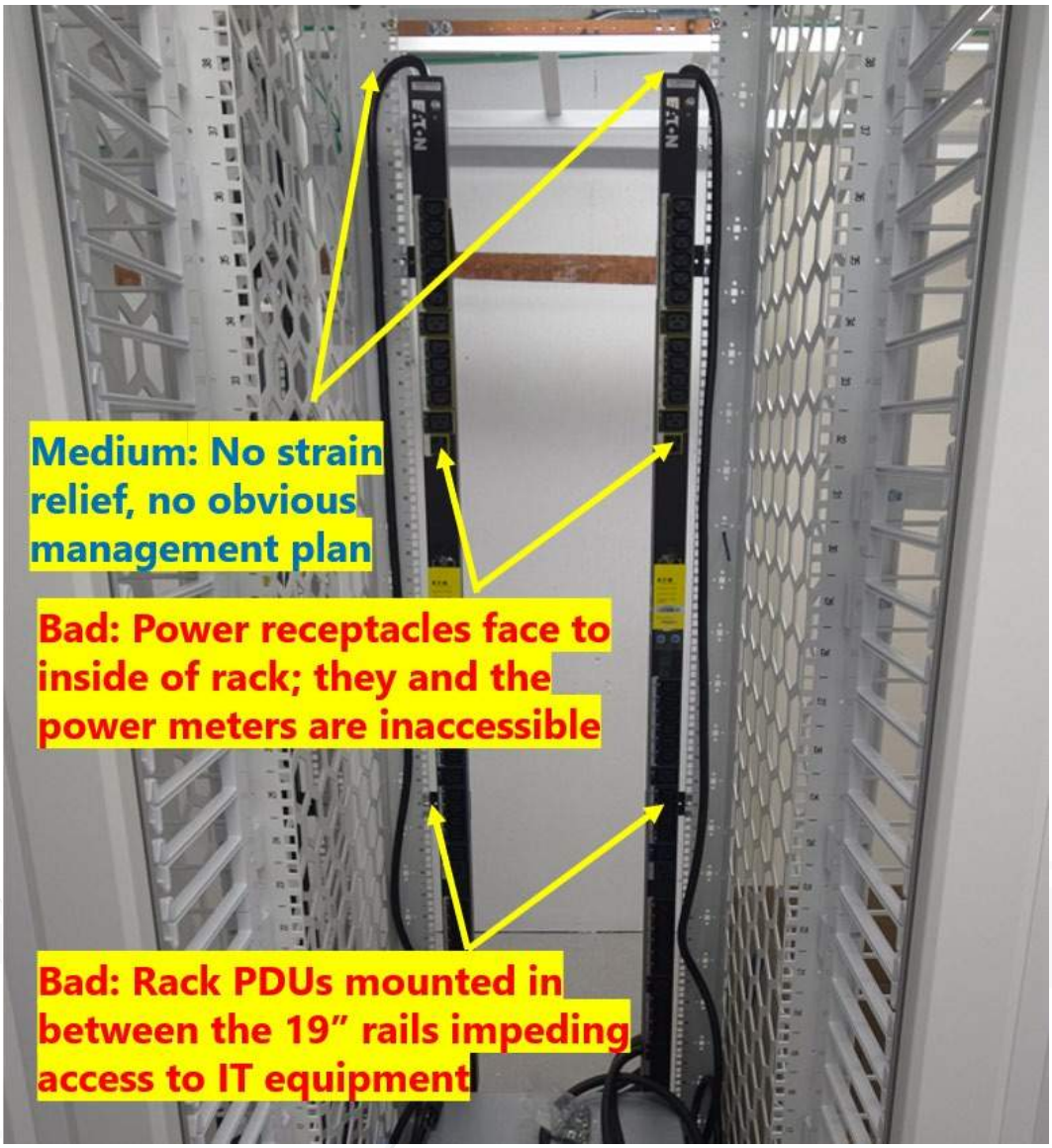

Figure 14. Quality Assurance Example. Inaccessible Rack PDUs, Blocking IT Equipment Access.

If properly planned and executed, this may be a reasonable manner in which to mount the Rack PDUs. Remember that UPS and Zone PDU equipment are located at the bottom of the rack. Strain relief and a larger bend radius for the power cables are needed here; lashing the cable to provide would reduce the sharp bend currently present.

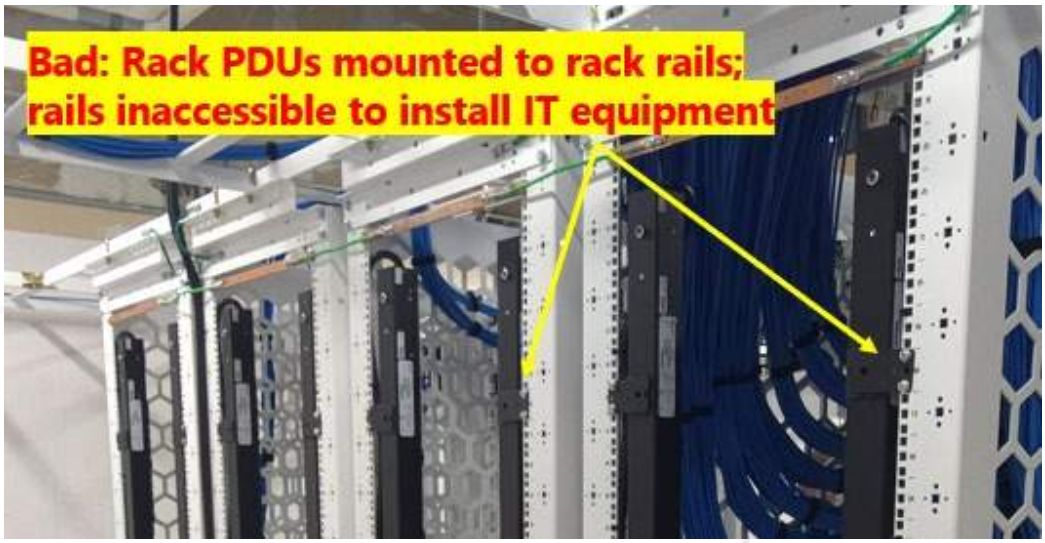

Figure 15. Quality Assurance Example. Inappropriate Rack PDU Mounting.

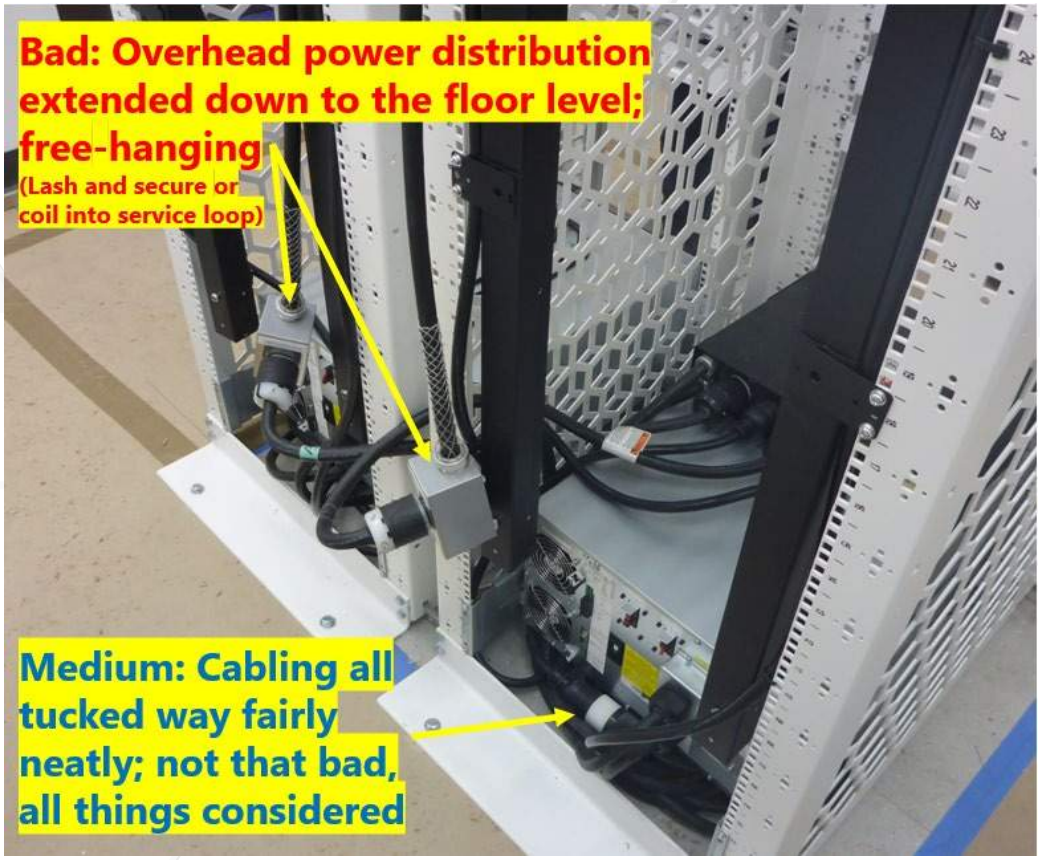

Figure 16. Quality Assurance Example. Incorrect Power Distribution Location.

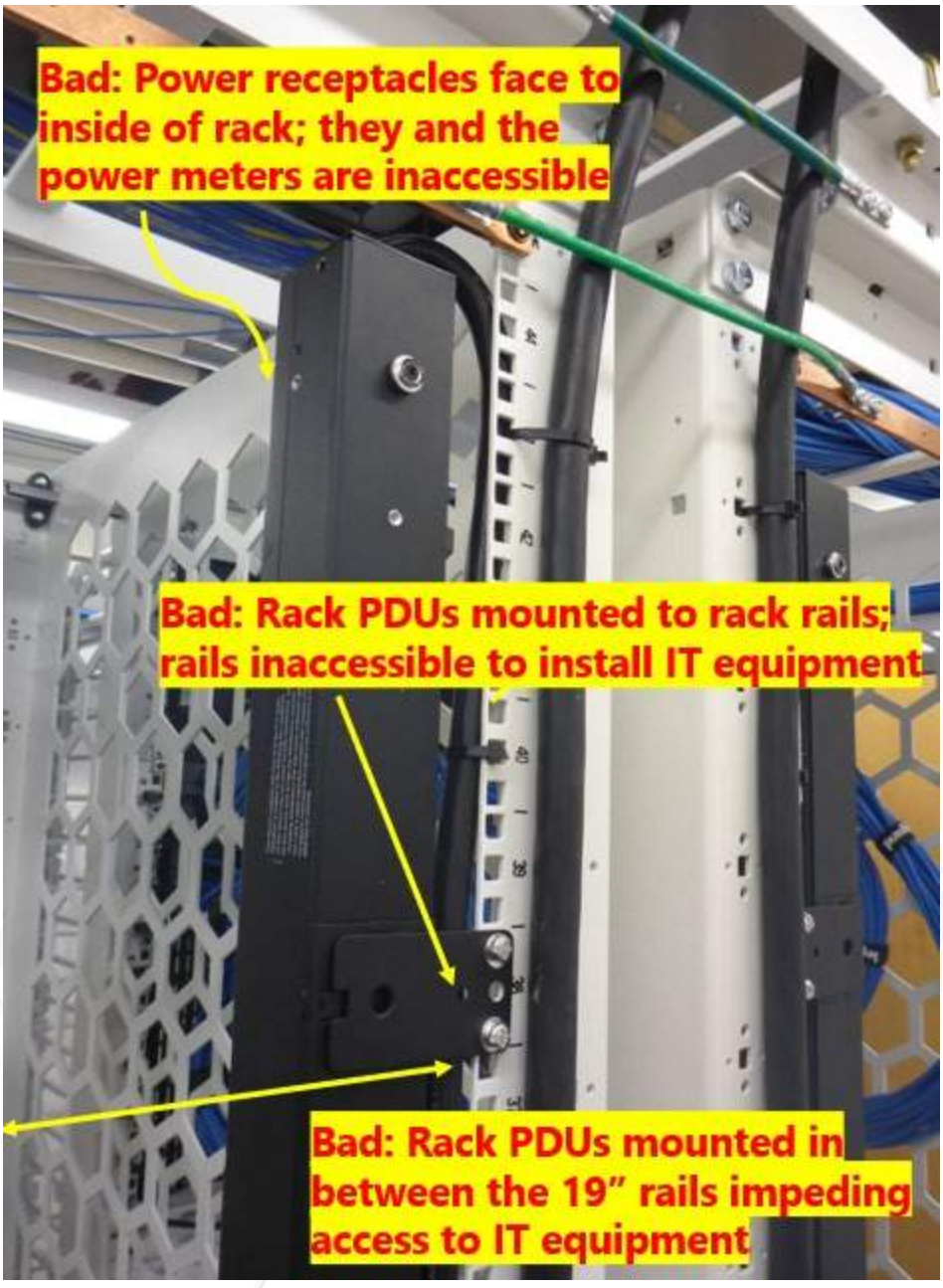

Figure 17. Quality Assurance Example. Inappropriate Use of Rack Rails.

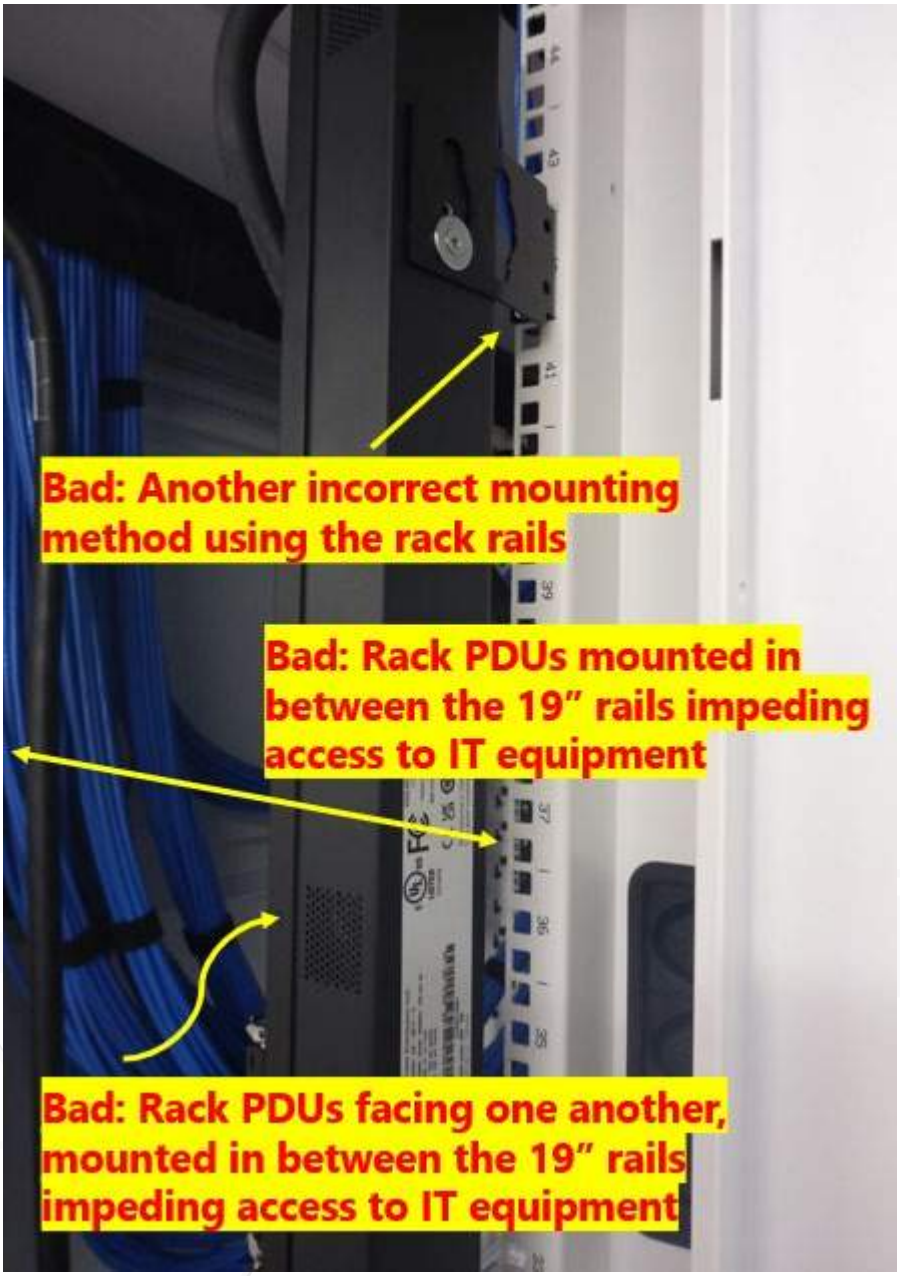

Figure 18. Quality Assurance Example. Incorrect Rack PDU Installation, Inappropriate Use of Rack Rails.

Figure 19. Quality Assurance Example. Incorrect Overhead Power Distribution.

Figure 20. Quality Assurance Example. Inappropriate Power Distribution Design.

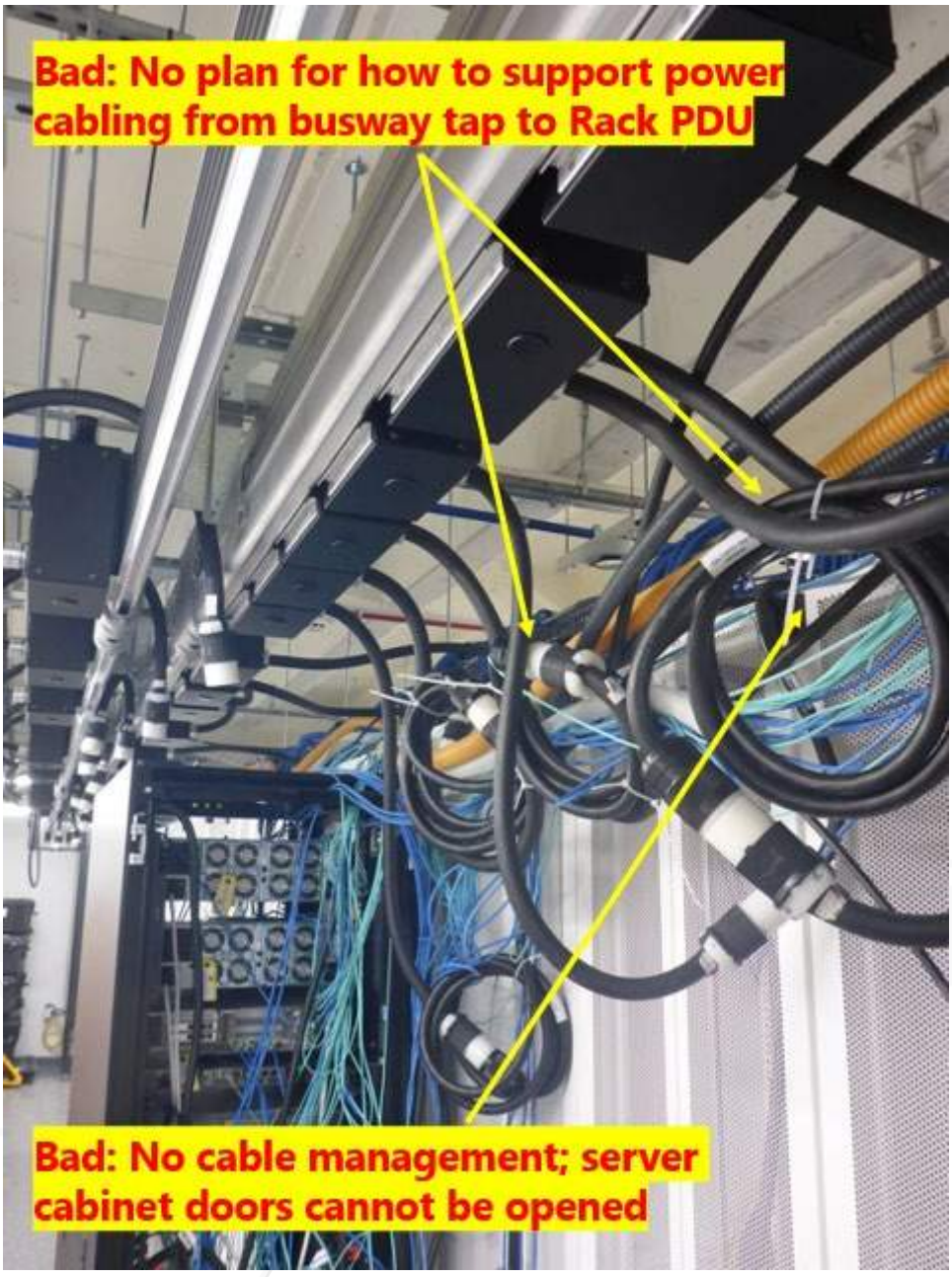

Figure 21. Quality Assurance Example. Incomplete Power Distribution Design.

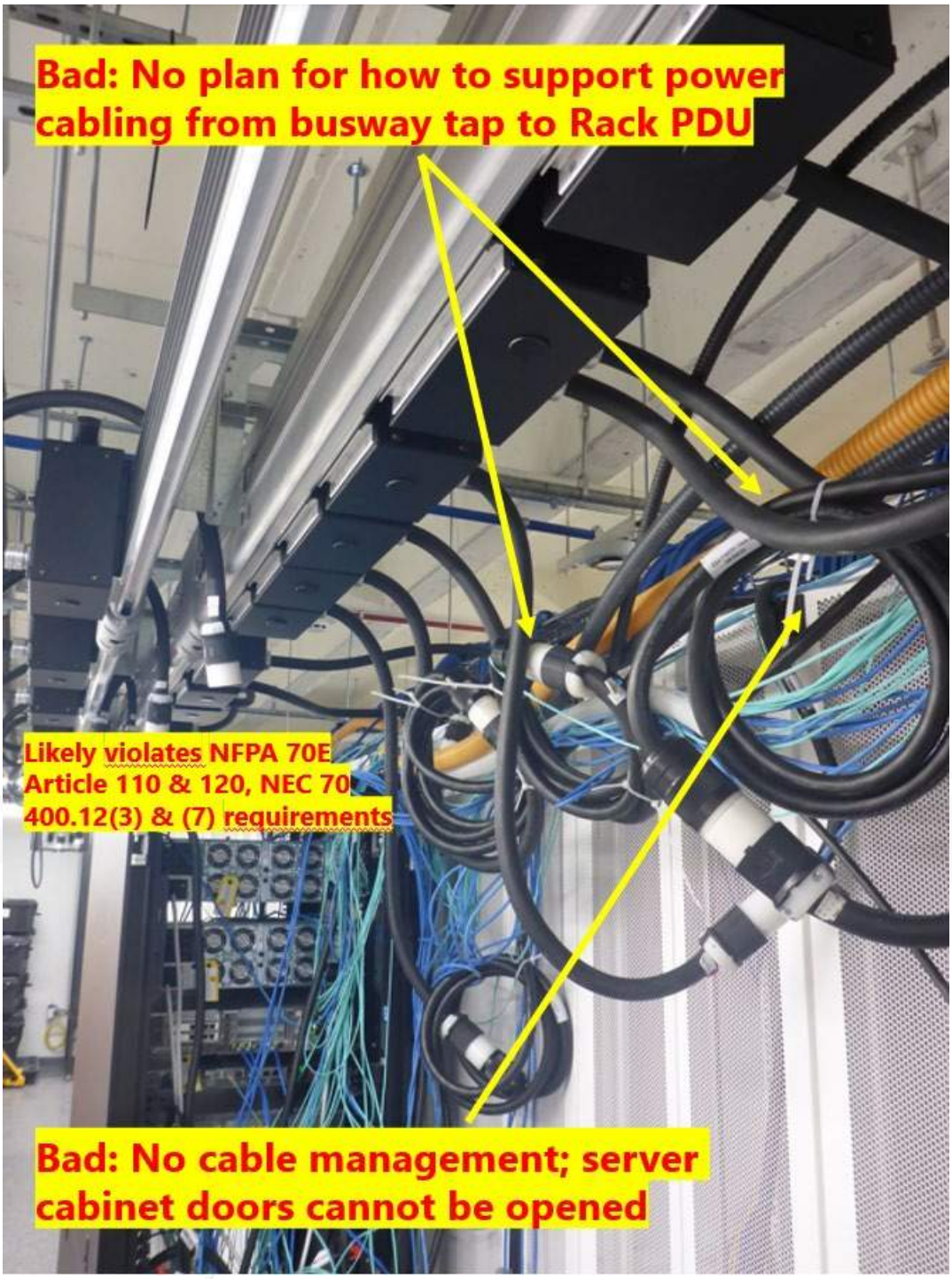

Figure 22. Quality Assurance Example. Incomplete Power Distribution Design.

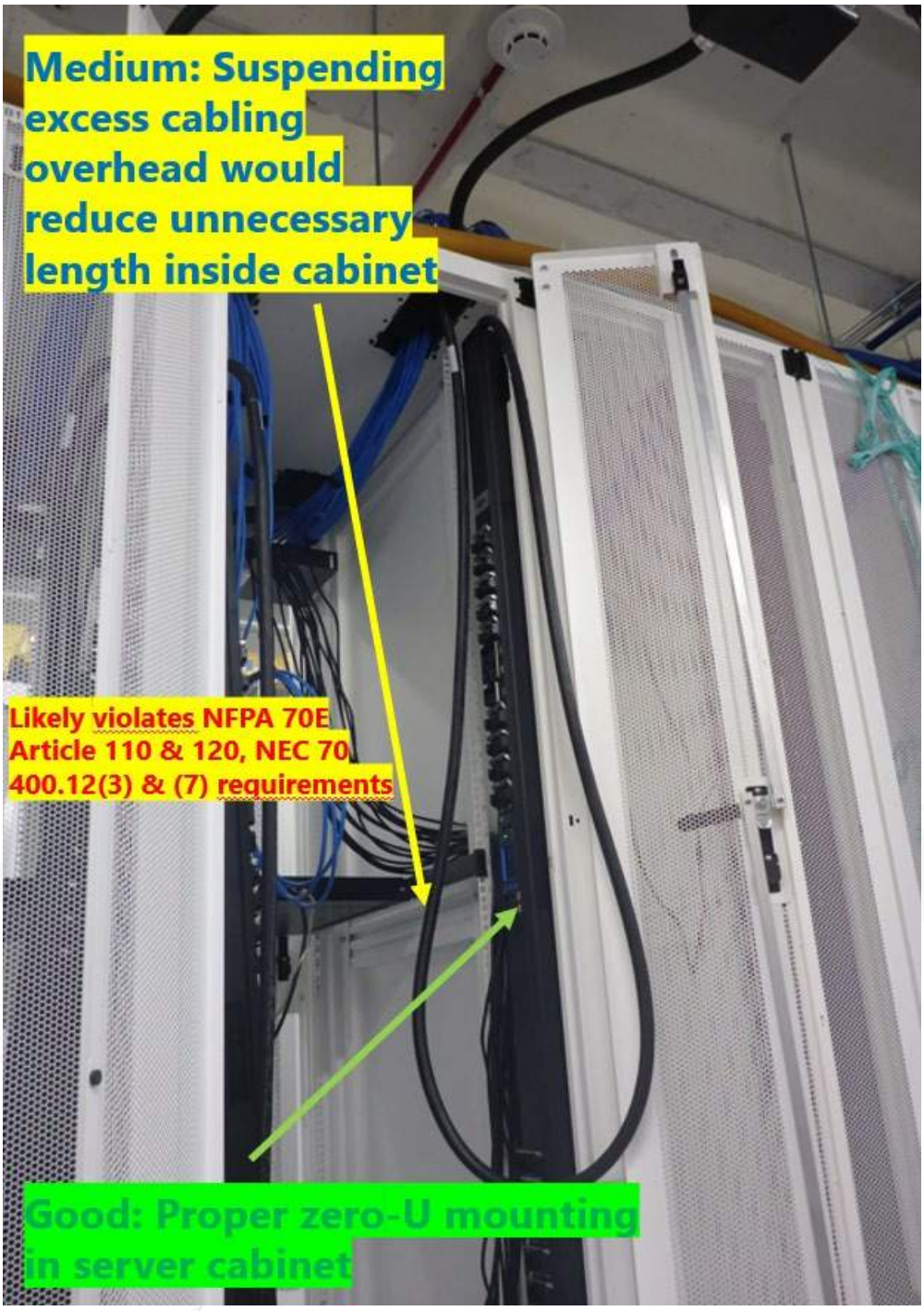

Figure 23. Quality Assurance Example. Lack of Power Cord Cabling Management.

Figure 24. Quality Assurance Example. Correct Power Cord Cabling Management.

Figure 25. Quality Assurance Example. Correct Power Cord Cabling Management.

Figures

Figure 1. Example of Adjustable Rack Rail with Square Hole Mounting. 2

Figure 2. Network Cabinets with Patching Equipment Front-Mounted. (a) Result of Improper Rail Position on Patch Cables. (b) This Is Despite the Front Rails Being Set Back Several Inches. (c) Proper Clearances for Patch Cables Achieved by Greater Setback. 3

Figure 3. Example of How to Make Rack Rail Adjustments (may vary by manufacturer). 4

Figure 4. Manufacturer's Example of Grommeted Side Panels. 5

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Figure 9. Rack PDU Mounting Options for Legacy & Existing Telecommunications Rooms. 11

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Figure 11. Quality Assurance Example. Rack PDUs Block IT Equipment Access. 12

Figure 12. Quality Assurance Example. Power Cable Management. 13

Figure 13. Quality Assurance Example. Power Cable Management. 13

Figure 14. Quality Assurance Example. Inaccessible Rack PDUs, Blocking IT Equipment Access. 14

Figure 15. Quality Assurance Example. Inappropriate Rack PDU Mounting. 15

Figure 16. Quality Assurance Example. Incorrect Power Distribution Location. 15

Figure 17. Quality Assurance Example. Inappropriate Use of Rack Rails. 16

Figure 18. Quality Assurance Example. Incorrect Rack PDU Installation, Inappropriate Use of Rack Rails. 17

Figure 19. Quality Assurance Example. Incorrect Overhead Power Distribution. 18

Figure 20. Quality Assurance Example. Inappropriate Power Distribution Design. 19

Figure 21. Quality Assurance Example. Incomplete Power Distribution Design. 20

Figure 22. Quality Assurance Example. Incomplete Power Distribution Design. 21

Figure 23. Quality Assurance Example. Lack of Power Cord Cabling Management. 22

Figure 24. Quality Assurance Example. Correct Power Cord Cabling Management. 23

Figure 25. Quality Assurance Example. Correct Power Cord Cabling Management..... 24

References

- VA Infrastructure Standard for Telecommunications Spaces
- VA IT Equipment Compatibility Standard
- VA PG-18-12 Telecommunications Design Guide

Change Register

Table 1: Change Register

Date	Description of Change
4/9/2025	Document Created

SecNum	SecName	ParNum	Submittal	Type
				of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three blue line copies of the interim schedule on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the
01 32 16.15	Project Schedules (Small Projects)	1.5.A.	THE COMPLETE PROJECT SCHEDULE SUBMITTAL	Contracting Officer. The contractor shall make a separate written detailed

01 32 16.15	Project Schedules (Small Projects)	1.5.B.	THE COMPLETE PROJECT SCHEDULE SUBMITTAL	Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following
01 32 16.15	Project Schedules (Small Projects)	1.5.C.	THE COMPLETE PROJECT SCHEDULE SUBMITTAL	The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.
01 32 16.15	Project Schedules (Small Projects)	1.5.D.	THE COMPLETE PROJECT SCHEDULE SUBMITTAL	The Complete Project Schedule shall contain approximately 300 work activities/events or approximately 25 work activities for each of the 12 buildings.
01 33 23	Shop Drawings, Product Data, and Sam	1.4.A.	SUBMITTAL REGISTER	The submittal register will list items of equipment and materials for which submittals are required by the specifications. This list may not be all inclusive and additional submittals may be required by the specifications. The Contractor is not relieved from supplying submittals required by the contract documents but which have been omitted from the submittal register.

01 33 23	Shop Drawings, Product Data, and Sam	1.4.B.	SUBMITTAL REGISTER	The submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.
01 33 23	Shop Drawings, Product Data, and Sam	1.4.C.	SUBMITTAL REGISTER	The VA will provide the initial submittal register in electronic format. Thereafter, the Contractor shall track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the VA. ▪▪
01 33 23	Shop Drawings, Product Data, and Sam	1.4.D.	SUBMITTAL REGISTER	The Contractor shall update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by Contracting Officer.
01 33 23	Shop Drawings, Product Data, and Sam	1.4.E.	SUBMITTAL REGISTER	The Contractor shall submit formal monthly updates to the submittal register in electronic format. Each monthly update shall document actual submission and approval dates for each submittal.
01 33 23	Shop Drawings, Product Data, and Sam	1.5.A.	SUBMITTAL SCHEDULING	Submittals are to be scheduled, submitted, reviewed, and approved prior to the acquisition of the material or equipment.

01 33 23	Shop Drawings, Product Data, and Sam	1.5.B.	SUBMITTAL SCHEDULING	Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for potential resubmittal.
01 33 23	Shop Drawings, Product Data, and Sam	1.5.C.	SUBMITTAL SCHEDULING	No delay costs or time extensions will be allowed for time lost in late submittals or resubmittals.
01 33 23	Shop Drawings, Product Data, and Sam	1.5.D.	SUBMITTAL SCHEDULING	All submittals are required to be approved prior to the start of the specified work activity.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.A.	SUBMITTAL PREPARATION	Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.B.	SUBMITTAL PREPARATION	Collect required data for each specific material, product, unit of work, or system into a single submittal. Prominently mark choices, options, and portions applicable to the submittal. Partial submittals will not be accepted for expedition of construction effort. Submittal will be returned without review if incomplete.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.C.	SUBMITTAL PREPARATION	If available product data is incomplete, provide Contractor-prepared documentation to supplement product data and satisfy submittal requirements.

01 33 23	Shop Drawings, Product Data, and Sam	1.6.D.	SUBMITTAL PREPARATION	All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned with review.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.E.	SUBMITTAL PREPARATION	Provide a transmittal form for each submittal with the following information
01 33 23	Shop Drawings, Product Data, and Sam	1.6.F.	SUBMITTAL PREPARATION	The Contractor shall be responsible for reviewing and certifying that all submittals are in compliance with contract requirements before submitting for VA review. Proposed deviations from the contract requirements shall be clearly identified. All deviations submitted shall include a side by side comparison of item being proposed against item specified. Failure to point out deviations will result in the VA requiring removal and replacement of such work at the Contractor's expense.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.G.	SUBMITTAL PREPARATION	Stamp, sign, and date each submittal transmittal form indicating action taken.

01 33 23	Shop Drawings, Product Data, and Sam	1.6.H.	SUBMITTAL PREPARATION	Submittals that are found to not meet contract requirements will be rejected and any perceived delay caused by incorrect/incomplete/rejected submittals is solely the contractor's responsibility and not the fault of the Government.
01 33 23	Shop Drawings, Product Data, and Sam	1.6.I.	SUBMITTAL PREPARATION	Stamp used by the Contractor on the submittal transmittal form to certify that the submittal meets contract requirements is to be similar to the following
01 33 23	Shop Drawings, Product Data, and Sam	1.7.A.	SUBMITTAL FORMAT AND TRANSMISSION	Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer.
01 33 23	Shop Drawings, Product Data, and Sam	1.7.B.	SUBMITTAL FORMAT AND TRANSMISSION	Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents.
01 33 23	Shop Drawings, Product Data, and Sam	1.7.C.	SUBMITTAL FORMAT AND TRANSMISSION	Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines shall be required.

01 33 23	Shop Drawings, Product Data, and Sam	1.7.D.	SUBMITTAL FORMAT AND TRANSMISSION	Provide all documents through an Electronic Submittal system. Confirm that the Electronic Submittal system can be accessed from the VA computer network. The Contractor is responsible for setting up, providing, and maintaining the Electronic Submittal system for the construction contract period of performance.
01 33 23	Shop Drawings, Product Data, and Sam	1.7.E.	SUBMITTAL FORMAT AND TRANSMISSION	Provide hard copies of submittals when requested by the Contracting Officer. Up to 3 additional hard copies of any submittal may be requested at the discretion of the Contracting Officer, at no additional cost to the VA.
01 33 23	Shop Drawings, Product Data, and Sam	1.13.A.	VA REVIEW OF SUBMITTALS AND RFIS	The VA will review all submittals for compliance with the technical requirements of the contract documents. The Architect-Engineer for this project will assist the VA in reviewing all submittals and determining contractual compliance. Review will be only for conformance with the applicable codes, standards and contract requirements.
01 33 23	Shop Drawings, Product Data, and Sam	1.13.B.	VA REVIEW OF SUBMITTALS AND RFIS	Period of review for submittals begins when the VA COR receives submittal from the Contractor.
01 33 23	Shop Drawings, Product Data, and Sam	1.13.C.	VA REVIEW OF SUBMITTALS AND RFIS	Period of review for each resubmittal is the same as for initial submittal.

01 33 23	Shop Drawings, Product Data, and Sam	1.13.D.	VA REVIEW OF SUBMITTALS AND RFIS	VA review period is 21 calendar days for submittals.
01 33 23	Shop Drawings, Product Data, and Sam	1.13.E.	VA REVIEW OF SUBMITTALS AND RFIS	VA review period is 21 calendar days for RFIs.
01 33 23	Shop Drawings, Product Data, and Sam	1.13.F.	VA REVIEW OF SUBMITTALS AND RFIS	The VA will return submittals to the Contractor with the following notations
01 33 23	Shop Drawings, Product Data, and Sam	1.14.A.	APPROVED SUBMITTALS	The VA approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.
01 33 23	Shop Drawings, Product Data, and Sam	1.14.B.	APPROVED SUBMITTALS	VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.
01 33 23	Shop Drawings, Product Data, and Sam	1.14.C.	APPROVED SUBMITTALS	After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

01 33 23	Shop Drawings, Product Data, and Sam	1.14.D.	APPROVED SUBMITTALS	Retain a copy of all approved submittals at project site, including approved samples.
01 45 00	QUALITY CONTROL	1.3.A.	SUBMITTALS	Government approval is required for all submittals. CQC inspection reports shall be submitted under this Specification section and follow the Applicable Specification section naming convention.
01 45 00	QUALITY CONTROL	3.5.A.	SUBMITTALS AND DELIVERABLES:	Submittals have to comply with the requirements in Section 01 33 23 Shop Drawings, Product Data, and Samples. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 01 91 00 General Commissioning Requirements is included in the contract, the submittals required by the section have to be coordinated with the Section 01 33 23 Shop Drawings, Product Data, and Samples to ensure adequate time is allowed for each type of submittal required.
01 57 19	Temporary Environmental Controls	1.4.A.	SUBMITTALS	In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following

01 57 19	Temporary Environmental Controls	1.4.B.	SUBMITTALS	Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.
01 74 19	Construction Waste Management	1.5.A.	SUBMITTALS	In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following
01 74 19	Construction Waste Management	1.5.B.	SUBMITTALS	Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information
01 74 19	Construction Waste Management	1.5.C.	SUBMITTALS	Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
01 74 19	Construction Waste Management	1.5.D.	SUBMITTALS	Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.
01 74 19	Construction Waste Management	1.5.E.	SUBMITTALS	Target waste diversion rate by material and an overall diversion rate.
01 74 19	Construction Waste Management	1.5.F.	SUBMITTALS	Final report documenting the results of implementation of the preconstruction waste management plan.

01 81 13	Sustainable Construction Requirement	1.5.A.	SUBMITTALS	All submittals to be provided by contractor to COR.
01 81 13	Sustainable Construction Requirement	1.5.B.	SUBMITTALS	Sustainability Action Plan
01 81 13	Sustainable Construction Requirement	1.5.C.	SUBMITTALS	Low Pollutant-Emitting Materials Tracking Spreadsheet
01 81 13	Sustainable Construction Requirement	1.5.D.	SUBMITTALS	Construction Indoor Air Quality (IAQ) Management Plan
01 81 13	Sustainable Construction Requirement	1.5.E.	SUBMITTALS	Product Submittals
01 81 13	Sustainable Construction Requirement	1.5.F.	SUBMITTALS	Sustainable Construction Progress Reports
01 81 13	Sustainable Construction Requirement	1.5.G.	SUBMITTALS	Closeout Submittals
01 91 00	General Commissioning Requirements	1.13.A.	SUBMITTALS	Preliminary Commissioning Plan Submittal
01 91 00	General Commissioning Requirements	1.13.B.	SUBMITTALS	Final Commissioning Plan Submittal
01 91 00	General Commissioning Requirements	1.13.C.	SUBMITTALS	Systems Functional Performance Test Procedure
01 91 00	General Commissioning Requirements	1.13.D.	SUBMITTALS	Pre-Functional Checklists
01 91 00	General Commissioning Requirements	1.13.E.	SUBMITTALS	Test and Inspection Reports
01 91 00	General Commissioning Requirements	1.13.F.	SUBMITTALS	Corrective Action Documents
01 91 00	General Commissioning Requirements	1.13.G.	SUBMITTALS	Preliminary Commissioning Report Submittal
01 91 00	General Commissioning Requirements	1.13.H.	SUBMITTALS	Final Commissioning Report Submittal
01 91 00	General Commissioning Requirements	1.13.I.	SUBMITTALS	Data for Commissioning
03 30 00	Cast-In-Place Concrete	1.6.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES. All items indicated below are required submittals requiring Contracting Officer's Representative (COR) review and approval.
03 30 00	Cast-In-Place Concrete	1.6.B.	SUBMITTALS	Shop Drawings
03 30 00	Cast-In-Place Concrete	1.6.C.	SUBMITTALS	Mill Test Reports

03 30 00	Cast-In-Place Concrete	1.6.D.	SUBMITTALS	Manufacturer's Certificates
03 30 00	Cast-In-Place Concrete	1.6.E.	SUBMITTALS	Testing Agency for Concrete Mix Design
03 30 00	Cast-In-Place Concrete	1.6.F.	SUBMITTALS	Test Report for Concrete Mix Designs
03 30 00	Cast-In-Place Concrete	1.6.G.	SUBMITTALS	Test reports on splitting tensile strength (Fct) of lightweight concrete.
05 12 00	Structural Steel Framing	1.4.A.	SUBMITTALS	Submittal Procedures
05 12 00	Structural Steel Framing	1.4.B.	SUBMITTALS	Submittal Drawings
05 12 00	Structural Steel Framing	1.4.C.	SUBMITTALS	Sustainable Construction Submittals
05 12 00	Structural Steel Framing	1.4.D.	SUBMITTALS	Test Reports
05 12 00	Structural Steel Framing	1.4.E.	SUBMITTALS	Certificates
05 12 00	Structural Steel Framing	1.4.F.	SUBMITTALS	Qualifications
05 12 00	Structural Steel Framing	1.4.G.	SUBMITTALS	Record Surveys
05 40 00	Cold-Formed Metal Framing	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer’s Representative (COR) review and approval
05 40 00	Cold-Formed Metal Framing	1.4.B.	SUBMITTALS	Shop Drawings
05 40 00	Cold-Formed Metal Framing	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data

05 40 00	Cold-Formed Metal Framing	1.4.D.	SUBMITTALS	Design of the light gauge for this project shall be provided by the contractor’s structural engineer for the loads shown on the construction documents. Submit signed and sealed calculations performed by a structural engineer with at least 5 years experience in the design of light gauge metal and registered in the state of the project. Calculations shall be submitted with plans elevations and details for review and approval.
05 40 00	Cold-Formed Metal Framing	1.4.E.	SUBMITTALS	Blast Design Calculations
05 40 00	Cold-Formed Metal Framing	1.4.F.	SUBMITTALS	Sustainable Construction Submittals
05 50 00	Metal Fabrications	1.3.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
05 50 00	Metal Fabrications	1.3.B.	SUBMITTALS	Manufacturer's Literature and Data
05 50 00	Metal Fabrications	1.3.C.	SUBMITTALS	Shop Drawings
05 50 00	Metal Fabrications	1.3.D.	SUBMITTALS	Manufacturer's Certificates
05 50 00	Metal Fabrications	1.3.E.	SUBMITTALS	Design Calculations for specified live loads including dead loads.
05 50 00	Metal Fabrications	1.3.F.	SUBMITTALS	Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.
06 10 00	Rough Carpentry	1.3.A.	SUBMITTALS:	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

06 10 00	Rough Carpentry	1.3.B.	SUBMITTALS:	Sustainable Design Submittals, as described below
06 10 00	Rough Carpentry	1.3.C.	SUBMITTALS:	Manufacturer’s Literature and Data
06 10 00	Rough Carpentry	1.3.D.	SUBMITTALS:	Manufacturer’s certificate for unmarked lumber.
06 20 00	Finish Carpentry	1.5.A.	SUBMITTALS	Submittal Procedures
06 20 00	Finish Carpentry	1.5.B.	SUBMITTALS	Submittal Drawings
06 20 00	Finish Carpentry	1.5.C.	SUBMITTALS	Manufacturer's Literature and Data
06 20 00	Finish Carpentry	1.5.D.	SUBMITTALS	Sustainable Construction Submittals
06 20 00	Finish Carpentry	1.5.E.	SUBMITTALS	Certificates
06 20 00	Finish Carpentry	1.5.F.	SUBMITTALS	Qualifications
07 21 13	Thermal Insulation	1.3.A.	SUBMITTALS:	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES .
07 21 13	Thermal Insulation	1.3.B.	SUBMITTALS:	Manufacturer's Literature and Data
07 21 13	Thermal Insulation	1.3.C.	SUBMITTALS:	Certificates
07 60 00	Flashing and Sheet Metal	1.5.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
07 60 00	Flashing and Sheet Metal	1.5.B.	SUBMITTALS	Shop Drawings
07 60 00	Flashing and Sheet Metal	1.5.C.	SUBMITTALS	Manufacturer's Literature and Data
07 60 00	Flashing and Sheet Metal	1.5.D.	SUBMITTALS	Certificates
07 81 00	Applied Fireproofing	1.3.A.	SUBMITTALS:	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
07 81 00	Applied Fireproofing	1.3.B.	SUBMITTALS:	Sustainable Design Submittals, as described below
07 81 00	Applied Fireproofing	1.3.C.	SUBMITTALS:	Installer qualifications.
07 81 00	Applied Fireproofing	1.3.D.	SUBMITTALS:	Testing laboratory accreditations.
07 81 00	Applied Fireproofing	1.3.E.	SUBMITTALS:	Manufacturer's Literature and Data
07 81 00	Applied Fireproofing	1.3.F.	SUBMITTALS:	Certificates
07 81 00	Applied Fireproofing	1.3.G.	SUBMITTALS:	Miscellaneous

07 84 00	Firestopping	1.3.	SUBMITTALS:	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
07 84 00	Firestopping	1.3.A.	SUBMITTALS:	Installer qualifications.
07 84 00	Firestopping	1.3.B.	SUBMITTALS:	Inspector qualifications.
07 84 00	Firestopping	1.3.C.	SUBMITTALS:	Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
07 84 00	Firestopping	1.3.D.	SUBMITTALS:	List of FM, UL, or WH classification number of systems installed.
07 84 00	Firestopping	1.3.E.	SUBMITTALS:	Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.
07 84 00	Firestopping	1.3.F.	SUBMITTALS:	Submit certificates from manufacturer attesting that firestopping materials comply with the specified requirements.
07 92 00	Joint Sealants	1.5.A.	SUBMITTALS:	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
07 92 00	Joint Sealants	1.5.B.	SUBMITTALS:	Installer qualifications.
07 92 00	Joint Sealants	1.5.C.	SUBMITTALS:	Contractor certification.
07 92 00	Joint Sealants	1.5.D.	SUBMITTALS:	Manufacturer's installation instructions for each product used.
07 92 00	Joint Sealants	1.5.E.	SUBMITTALS:	Cured samples of exposed sealants for each color.
07 92 00	Joint Sealants	1.5.F.	SUBMITTALS:	Manufacturer's Literature and Data
07 92 00	Joint Sealants	1.5.G.	SUBMITTALS:	Manufacturer warranty.
08 11 13	Hollow Metal Doors and Frames	1.4.A.	SUBMITTALS	Submittal Procedures
08 11 13	Hollow Metal Doors and Frames	1.4.B.	SUBMITTALS	Submittal Drawings
08 11 13	Hollow Metal Doors and Frames	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data

08 11 13	Hollow Metal Doors and Frames	1.4.D.	SUBMITTALS	Sustainable Construction Submittals
08 11 13	Hollow Metal Doors and Frames	1.4.E.	SUBMITTALS	Test reports
08 11 13	Hollow Metal Doors and Frames	1.4.F.	SUBMITTALS	Qualifications
08 14 00	Interior Wood Doors	1.4.A.	SUBMITTALS	Submittal Procedures
08 14 00	Interior Wood Doors	1.4.B.	SUBMITTALS	Submittal Drawings
08 14 00	Interior Wood Doors	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data
08 14 00	Interior Wood Doors	1.4.D.	SUBMITTALS	Sustainable Construction Submittals
08 14 00	Interior Wood Doors	1.4.E.	SUBMITTALS	Test Reports
08 14 00	Interior Wood Doors	1.4.F.	SUBMITTALS	Operation and Maintenance Data
08 71 00	Door Hardware	1.6.A.	SUBMITTALS	Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).
08 71 00	Door Hardware	1.6.B.	SUBMITTALS	Hardware Schedule
08 71 00	Door Hardware	1.6.C.	SUBMITTALS	Samples and Manufacturers' Literature
08 71 00	Door Hardware	1.6.D.	SUBMITTALS	Certificate of Compliance and Test Reports
09 05 16	Subsurface Preparation for Floor Finish	1.3.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.
09 05 16	Subsurface Preparation for Floor Finish	1.3.B.	SUBMITTALS	Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer
09 05 16	Subsurface Preparation for Floor Finish	1.3.C.	SUBMITTALS	Product Data
09 05 16	Subsurface Preparation for Floor Finish	1.3.D.	SUBMITTALS	Test Data

09 22 16	Non-Structural Metal Framing	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
09 22 16	Non-Structural Metal Framing	1.4.B.	SUBMITTALS	Manufacturer's Literature and Data
09 22 16	Non-Structural Metal Framing	1.4.C.	SUBMITTALS	Shop Drawings
09 22 16	Non-Structural Metal Framing	1.4.D.	SUBMITTALS	Test Results
09 29 00	Gypsum Board	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
09 29 00	Gypsum Board	1.4.B.	SUBMITTALS	Manufacturer's Literature and Data
09 29 00	Gypsum Board	1.4.C.	SUBMITTALS	Shop Drawings
09 29 00	Gypsum Board	1.4.D.	SUBMITTALS	Samples
09 29 00	Gypsum Board	1.4.E.	SUBMITTALS	Test Results
09 29 00	Gypsum Board	1.4.F.	SUBMITTALS	Certificates
09 51 00	Acoustical Ceilings	1.5.A.	SUBMITTALS	Submittal Procedures
09 51 00	Acoustical Ceilings	1.5.B.	SUBMITTALS	Submittal Drawings
09 51 00	Acoustical Ceilings	1.5.C.	SUBMITTALS	Manufacturer's Literature and Data
09 51 00	Acoustical Ceilings	1.5.D.	SUBMITTALS	Samples
09 51 00	Acoustical Ceilings	1.5.E.	SUBMITTALS	Sustainable Construction Submittals
09 51 00	Acoustical Ceilings	1.5.F.	SUBMITTALS	Certificates
09 51 00	Acoustical Ceilings	1.5.G.	SUBMITTALS	Qualifications
09 51 00	Acoustical Ceilings	1.5.H.	SUBMITTALS	Operation and Maintenance Data
09 65 13	Resilient Base and Accessories	1.4.A.	SUBMITTALS	Submittal Procedures
09 65 13	Resilient Base and Accessories	1.4.B.	SUBMITTALS	Manufacturer's Literature and Data
09 65 13	Resilient Base and Accessories	1.4.C.	SUBMITTALS	Samples
09 65 13	Resilient Base and Accessories	1.4.D.	SUBMITTALS	Sustainable Construction Submittals
09 65 13	Resilient Base and Accessories	1.4.E.	SUBMITTALS	Operation and Maintenance Data
09 69 00	Access Flooring	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
09 69 00	Access Flooring	1.4.B.	SUBMITTALS	Sustainable Design Submittals, as described below
09 69 00	Access Flooring	1.4.C.	SUBMITTALS	Samples

09 69 00	Access Flooring	1.4.D.	SUBMITTALS	Shop Drawings
09 69 00	Access Flooring	1.4.E.	SUBMITTALS	Manufacturer’s Literature and Data
09 69 00	Access Flooring	1.4.F.	SUBMITTALS	Manufacturer’s Certificates
09 69 00	Access Flooring	1.4.G.	SUBMITTALS	Floor System Test Reports
09 69 00	Access Flooring	1.4.H.	SUBMITTALS	Manufacturer’s Qualifications.
09 69 00	Access Flooring	1.4.I.	SUBMITTALS	Installer’s Qualifications.
09 69 00	Access Flooring	1.4.J.	SUBMITTALS	Seismic Calculations.
09 91 00	Painting	1.3.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
09 91 00	Painting	1.3.B.	SUBMITTALS	Sustainable Design Submittals as described below
09 91 00	Painting	1.3.C.	SUBMITTALS	Painter qualifications.
09 91 00	Painting	1.3.D.	SUBMITTALS	Manufacturer's Literature and Data
09 91 00	Painting	1.3.E.	SUBMITTALS	Sample Panels
09 91 00	Painting	1.3.F.	SUBMITTALS	Sample of identity markers if used.
09 91 00	Painting	1.3.G.	SUBMITTALS	Manufacturers' Certificates indicating compliance with specified requirements
10 14 00	Signage	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
10 14 00	Signage	1.4.B.	SUBMITTALS	Sustainable Design Submittals, as described below
10 14 00	Signage	1.4.C.	SUBMITTALS	Interior Sign Samples
10 14 00	Signage	1.4.D.	SUBMITTALS	Exterior Sign Samples
10 14 00	Signage	1.4.E.	SUBMITTALS	Manufacturer's Literature
10 14 00	Signage	1.4.F.	SUBMITTALS	Sign Location Plan, showing location, type and total number of signs required.
10 14 00	Signage	1.4.G.	SUBMITTALS	Shop Drawings
10 14 00	Signage	1.4.H.	SUBMITTALS	Full size layout patterns for dimensional letters.

10 14 00	Signage	1.4.I.	SUBMITTALS	Manufacturer’s qualifications.
10 14 00	Signage	1.4.J.	SUBMITTALS	Installer’s qualifications.
10 26 00	Wall and Door Protection	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
10 26 00	Wall and Door Protection	1.4.B.	SUBMITTALS	Sustainable Design Submittals, as described below
10 26 00	Wall and Door Protection	1.4.C.	SUBMITTALS	Shop Drawings
10 26 00	Wall and Door Protection	1.4.D.	SUBMITTALS	Manufacturer's Literature and Data
10 26 00	Wall and Door Protection	1.4.E.	SUBMITTALS	Test Report
10 26 00	Wall and Door Protection	1.4.F.	SUBMITTALS	Manufacturer’s qualifications.
10 26 00	Wall and Door Protection	1.4.G.	SUBMITTALS	Installer’s qualifications.
10 26 00	Wall and Door Protection	1.4.H.	SUBMITTALS	Manufacturer’s warranty.
10 44 13	Fire Extinguisher Cabinets	1.3.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
10 44 13	Fire Extinguisher Cabinets	1.3.B.	SUBMITTALS	Manufacturer's Literature and Data
21 08 00	Commissioning of Fire Suppression Sys	1.6.A.	SUBMITTALS	The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

21 08 00	Commissioning of Fire Suppression Sys	1.6.B.	SUBMITTALS	The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

21 13 13	Wet-Pipe Sprinkler System	1.4.A.	SUBMITTALS	Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following

21 13 16	Dry-Pipe Sprinkler Systems	1.4.A.	SUBMITTALS	Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following

21 22 00	Clean Agent Fire Suppression Systems	1.4.A.	SUBMITTALS	Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level IV Special Hazards Suppression Systems Technician. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4 (A) 1 through 1.4 (A) 5 electronically in pdf format on a compact disc or as directed by the Contracting Officers Representative (COR). Submittals shall include, but not be limited to, the following
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

22 05 23	General-Duty Valves for Plumbing Pipin	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING”, with applicable paragraph identification.
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data including
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.D.	SUBMITTALS	Test and Balance reports for balancing valves.
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.E.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts and troubleshooting guide
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.F.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
22 05 23	General-Duty Valves for Plumbing Pipin	1.4.G.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

22 07 11	Plumbing Insulation	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
22 07 11	Plumbing Insulation	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION”, with applicable paragraph identification.
22 07 11	Plumbing Insulation	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data including
22 07 11	Plumbing Insulation	1.4.D.	SUBMITTALS	Shop Drawings
22 07 11	Plumbing Insulation	1.4.E.	SUBMITTALS	Samples
22 07 11	Plumbing Insulation	1.4.F.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

22 08 00	Commissioning of Plumbing Systems	1.6.A.	SUBMITTALS	The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
22 08 00	Commissioning of Plumbing Systems	1.6.B.	SUBMITTALS	The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
22 11 00	Facility Water Distribution	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
22 11 00	Facility Water Distribution	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS”, with applicable paragraph identification.
22 11 00	Facility Water Distribution	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data including

22 11 00	Facility Water Distribution	1.4.D.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts
22 11 00	Facility Water Distribution	1.4.E.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
22 11 00	Facility Water Distribution	1.4.F.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
22 13 00	Facility Sanitary and Vent Piping	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
22 13 00	Facility Sanitary and Vent Piping	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING”, with applicable paragraph identification.
22 13 00	Facility Sanitary and Vent Piping	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data including

22 13 00	Facility Sanitary and Vent Piping	1.4.D.	SUBMITTALS	Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.
22 13 00	Facility Sanitary and Vent Piping	1.4.E.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
22 13 00	Facility Sanitary and Vent Piping	1.4.F.	SUBMITTALS	Completed System Readiness Checklist provided by the CXA and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
22 13 00	Facility Sanitary and Vent Piping	1.4.G.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
23 05 11	Common Work Results for HVAC	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

23 05 11	Common Work Results for HVAC	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 05 11, COMMON WORK RESULTS FOR HVAC”, with applicable paragraph identification.
23 05 11	Common Work Results for HVAC	1.4.C.	SUBMITTALS	If the project is phased submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.

23 05 11	Common Work Results for HVAC	1.4.D.	SUBMITTALS	Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

23 05 11	Common Work Results for HVAC	1.4.E.	SUBMITTALS	If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
23 05 11	Common Work Results for HVAC	1.4.F.	SUBMITTALS	Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

23 05 11	Common Work Results for HVAC	1.4.G.	SUBMITTALS	Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.
23 05 11	Common Work Results for HVAC	1.4.H.	SUBMITTALS	Samples
23 05 11	Common Work Results for HVAC	1.4.I.	SUBMITTALS	Mock-ups
23 05 11	Common Work Results for HVAC	1.4.J.	SUBMITTALS	Coordination/Shop Drawings
23 05 11	Common Work Results for HVAC	1.4.K.	SUBMITTALS	Manufacturer's Literature and Data
23 05 11	Common Work Results for HVAC	1.4.L.	SUBMITTALS	Rigging Plan
23 05 11	Common Work Results for HVAC	1.4.M.	SUBMITTALS	HVAC Maintenance Data and Operating Instructions
23 05 11	Common Work Results for HVAC	1.4.N.	SUBMITTALS	Provide copies of approved HVAC equipment submittals to the TAB and Commissioning Subcontractor.
23 05 11	Common Work Results for HVAC	1.4.O.	SUBMITTALS	Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 05 11	Common Work Results for HVAC	1.4.P.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.

23 05 12	General Motor Requirements for HVAC	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 05 12	General Motor Requirements for HVAC	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT”, with applicable paragraph identification.
23 05 12	General Motor Requirements for HVAC	1.4.C.	SUBMITTALS	Submit motor submittals with driven equipment.
23 05 12	General Motor Requirements for HVAC	1.4.D.	SUBMITTALS	Shop Drawings
23 05 12	General Motor Requirements for HVAC	1.4.E.	SUBMITTALS	Manufacturer's Literature and Data including
23 05 12	General Motor Requirements for HVAC	1.4.F.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide
23 05 12	General Motor Requirements for HVAC	1.4.G.	SUBMITTALS	Certification

23 05 12	General Motor Requirements for HVAC	1.4.H.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 05 12	General Motor Requirements for HVAC	1.4.I.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 05 41	Noise and Vibration Control for HVAC P	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
23 05 41	Noise and Vibration Control for HVAC P	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE”, with applicable paragraph identification.
23 05 41	Noise and Vibration Control for HVAC P	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 05 41	Noise and Vibration Control for HVAC P	1.4.D.	SUBMITTALS	Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 05 93, SECTION TITLE”, with applicable paragraph identification.
23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.C.	SUBMITTALS	Submit names and qualifications of TAB agency and TAB Specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.D.	SUBMITTALS	For use by the COR staff, submit one complete set of applicable AABC, NEBB or TABB publications that will be the basis of TAB work.
23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.E.	SUBMITTALS	Submit the following for review and approval
23 05 93	TESTING, ADJUSTING, AND BALANCIN(	1.4.F.	SUBMITTALS	Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area with noted critical paths.
23 07 11	HVAC, Plumbing, and Boiler Plant Insul	1.4.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
23 07 11	HVAC, Plumbing, and Boiler Plant Insul	1.4.B.	SUBMITTALS	Shop Drawings
23 07 11	HVAC, Plumbing, and Boiler Plant Insul	1.4.C.	SUBMITTALS	Samples

23 08 00	Commissioning of HVAC Systems	1.6.A.	SUBMITTALS	The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
23 08 00	Commissioning of HVAC Systems	1.6.B.	SUBMITTALS	The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
23 09 23	Direct-Digital Control System for HVAC	1.7.A.	SUBMITTALS	Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 09 23	Direct-Digital Control System for HVAC	1.7.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC”, with applicable paragraph identification.
23 09 23	Direct-Digital Control System for HVAC	1.7.C.	SUBMITTALS	Manufacturer’s Literature and Data Including
23 09 23	Direct-Digital Control System for HVAC	1.7.D.	SUBMITTALS	Product Certificates

23 09 23	Direct-Digital Control System for HVAC	1.7.E.	SUBMITTALS	Validation Test Plan
23 09 23	Direct-Digital Control System for HVAC	1.7.F.	SUBMITTALS	Licenses
23 09 23	Direct-Digital Control System for HVAC	1.7.G.	SUBMITTALS	As Built Control Drawings
23 09 23	Direct-Digital Control System for HVAC	1.7.H.	SUBMITTALS	Operation and Maintenance (O/M) Manuals)
23 09 23	Direct-Digital Control System for HVAC	1.7.I.	SUBMITTALS	Submit Performance Report to COR prior to final inspection.
23 21 13	Hydronic Piping	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 21 13	Hydronic Piping	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING”, with applicable paragraph identification.
23 21 13	Hydronic Piping	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 21 13	Hydronic Piping	1.4.D.	SUBMITTALS	Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels
23 21 13	Hydronic Piping	1.4.E.	SUBMITTALS	Submit the welder’s qualifications in the form of a current (less than 1-year old) and formal certificate.
23 21 13	Hydronic Piping	1.4.F.	SUBMITTALS	Coordination Drawings
23 21 13	Hydronic Piping	1.4.G.	SUBMITTALS	As-Built Piping Diagrams
23 21 13	Hydronic Piping	1.4.H.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide

23 21 13	Hydronic Piping	1.4.I.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 21 13	Hydronic Piping	1.4.J.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 21 23	Hydronic Pumps	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 21 23	Hydronic Pumps	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION XX XX XX, SECTION TITLE”, with applicable paragraph identification.
23 21 23	Hydronic Pumps	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 21 23	Hydronic Pumps	1.4.D.	SUBMITTALS	Characteristic Curves
23 21 23	Hydronic Pumps	1.4.E.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide

23 21 23	Hydronic Pumps	1.4.F.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 21 23	Hydronic Pumps	1.4.G.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 22 13	Steam and Condensate Heating Piping	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 22 13	Steam and Condensate Heating Piping	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 22 13, STEAM AND CONDENSATE HEATING PIPING”, with applicable paragraph identification.
23 22 13	Steam and Condensate Heating Piping	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data including
23 22 13	Steam and Condensate Heating Piping	1.4.D.	SUBMITTALS	Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels
23 22 13	Steam and Condensate Heating Piping	1.4.E.	SUBMITTALS	Coordination Drawings
23 22 13	Steam and Condensate Heating Piping	1.4.F.	SUBMITTALS	As-Built Piping Diagrams

23 22 13	Steam and Condensate Heating Piping	1.4.G.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide
23 22 13	Steam and Condensate Heating Piping	1.4.H.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 22 13	Steam and Condensate Heating Piping	1.4.I.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 25 00	HVAC Water Treatment	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 25 00	HVAC Water Treatment	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION XX XX XX, SECTION TITLE”, with applicable paragraph identification.
23 25 00	HVAC Water Treatment	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 25 00	HVAC Water Treatment	1.4.D.	SUBMITTALS	Water analysis verification.

23 25 00	HVAC Water Treatment	1.4.E.	SUBMITTALS	Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B0054.
23 25 00	HVAC Water Treatment	1.4.F.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 25 00	HVAC Water Treatment	1.4.G.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 25 00	HVAC Water Treatment	1.4.H.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING of HVAC SYSTEMS.
23 31 00	HVAC Ducts and Casings	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

23 31 00	HVAC Ducts and Casings	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE”, with applicable paragraph identification.
23 31 00	HVAC Ducts and Casings	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 31 00	HVAC Ducts and Casings	1.4.D.	SUBMITTALS	Coordination Drawings
23 31 00	HVAC Ducts and Casings	1.4.E.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 34 00	HVAC Fans	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 34 00	HVAC Fans	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 34 oo, HVAC FANS”, with applicable paragraph identification.
23 34 00	HVAC Fans	1.4.C.	SUBMITTALS	Manufacturers Literature and Data Including
23 34 00	HVAC Fans	1.4.D.	SUBMITTALS	Certified sound power levels for each fan.
23 34 00	HVAC Fans	1.4.E.	SUBMITTALS	Motor ratings, types, electrical characteristics, and accessories.

23 34 00	HVAC Fans	1.4.F.	SUBMITTALS	Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.
23 34 00	HVAC Fans	1.4.G.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 34 00	HVAC Fans	1.4.H.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 34 00	HVAC Fans	1.4.I.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 36 00	Air Terminal Units	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

23 36 00	Air Terminal Units	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE”, with applicable paragraph identification.
23 36 00	Air Terminal Units	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 36 00	Air Terminal Units	1.4.D.	SUBMITTALS	Samples
23 36 00	Air Terminal Units	1.4.E.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 36 00	Air Terminal Units	1.4.F.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 36 00	Air Terminal Units	1.4.G.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 37 00	Air Outlets and Inlets	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

23 37 00	Air Outlets and Inlets	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 37 00, AIR OUTLETS AND INLETS”, with applicable paragraph identification.
23 37 00	Air Outlets and Inlets	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 37 00	Air Outlets and Inlets	1.4.D.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 40 00	HVAC Air Cleaning Devices	1.4.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 40 00	HVAC Air Cleaning Devices	1.4.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 40 00, HVAC AIR CLEANING DEVICES”, with applicable paragraph identification.
23 40 00	HVAC Air Cleaning Devices	1.4.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 40 00	HVAC Air Cleaning Devices	1.4.D.	SUBMITTALS	Air Filter performance reports.
23 40 00	HVAC Air Cleaning Devices	1.4.E.	SUBMITTALS	Suppliers warranty.

23 40 00	HVAC Air Cleaning Devices	1.4.F.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide
23 64 00	PACKAGED WATER CHILLERS	1.5.A.	SUBMITTALS	Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
23 64 00	PACKAGED WATER CHILLERS	1.5.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE”, with applicable paragraph identification.
23 64 00	PACKAGED WATER CHILLERS	1.5.C.	SUBMITTALS	Manufacturer's Literature and Data Including
23 64 00	PACKAGED WATER CHILLERS	1.5.D.	SUBMITTALS	Run test report for all chillers.
23 64 00	PACKAGED WATER CHILLERS	1.5.E.	SUBMITTALS	Product Certificate
23 64 00	PACKAGED WATER CHILLERS	1.5.F.	SUBMITTALS	Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide

23 64 00	PACKAGED WATER CHILLERS	1.5.G.	SUBMITTALS	Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 64 00	PACKAGED WATER CHILLERS	1.5.H.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
23 81 23	Computer-Room Air-Conditioners	1.3.A.	SUBMITTALS	Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
23 81 23	Computer-Room Air-Conditioners	1.3.B.	SUBMITTALS	Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 23 81 23, COMPUTER-ROOM-AIR-CONDITIONERS”, with applicable paragraph identification.
23 81 23	Computer-Room Air-Conditioners	1.3.C.	SUBMITTALS	Manufacturer’s Literature and Data Including
23 81 23	Computer-Room Air-Conditioners	1.3.D.	SUBMITTALS	Submit detailed equipment assemblies with dimensions, operating weights, required clearances.
23 81 23	Computer-Room Air-Conditioners	1.3.E.	SUBMITTALS	Submit wiring diagrams for power, alarm and controls.
23 81 23	Computer-Room Air-Conditioners	1.3.F.	SUBMITTALS	Certification

23 81 23	Computer-Room Air-Conditioners	1.3.G.	SUBMITTALS	Completed System Readiness Checklists provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
23 81 23	Computer-Room Air-Conditioners	1.3.H.	SUBMITTALS	Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
25 10 10	Advanced Utility Metering System	1.7.A.	SUBMITTALS	Product Data
25 10 10	Advanced Utility Metering System	1.7.B.	SUBMITTALS	Shop Drawings
25 10 10	Advanced Utility Metering System	1.7.C.	SUBMITTALS	Software and Firmware Operational Documentation
25 10 10	Advanced Utility Metering System	1.7.D.	SUBMITTALS	Software Upgrade Kit
25 10 10	Advanced Utility Metering System	1.7.E.	SUBMITTALS	Firmware Upgrade Kit
25 10 10	Advanced Utility Metering System	1.7.F.	SUBMITTALS	Software licenses and upgrades required by and installed for operating and programming digital and analog devices.
25 10 10	Advanced Utility Metering System	1.7.G.	SUBMITTALS	Qualification Data
25 10 10	Advanced Utility Metering System	1.7.H.	SUBMITTALS	Other Informational Submittals
25 10 10	Advanced Utility Metering System	1.7.I.	SUBMITTALS	Revise and update the Contract Drawings to include details of the system design. Drawings shall be on 17 by 11 inches sheets. Details to be shown on the Design Drawing include
25 10 10	Advanced Utility Metering System	1.8.A.	CLOSEOUT SUBMITTALS	Operation and Maintenance Data

25 10 10	Advanced Utility Metering System	1.8.B.	CLOSEOUT SUBMITTALS	Field quality-control test reports.
26 05 11	Requirements for Electrical Installation	1.12.A.	SUBMITTALS	Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
26 05 11	Requirements for Electrical Installation	1.12.B.	SUBMITTALS	The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
26 05 11	Requirements for Electrical Installation	1.12.C.	SUBMITTALS	All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
26 05 11	Requirements for Electrical Installation	1.12.D.	SUBMITTALS	Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

26 05 11	Requirements for Electrical Installation	1.12.E.	SUBMITTALS	The submittals shall include the following
26 05 11	Requirements for Electrical Installation	1.12.F.	SUBMITTALS	Maintenance and Operation Manuals
26 05 11	Requirements for Electrical Installation	1.12.G.	SUBMITTALS	Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
26 05 11	Requirements for Electrical Installation	1.12.H.	SUBMITTALS	After approval and prior to installation, furnish the COR with one sample of each of the following
26 05 19	Low-Voltage Electrical Power Conducto	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 05 26	Grounding and Bonding for Electrical Sy	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 05 33	Raceway and Boxes for Electrical Syste	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 05 73	Overcurrent Protective Device Coordina	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements

26 08 00	Commissioning of Electrical Systems	1.6.A.	SUBMITTALS	The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
26 08 00	Commissioning of Electrical Systems	1.6.B.	SUBMITTALS	The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
26 09 23	Lighting Controls	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 22 00	Low-Voltage Transformers	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements

26 24 16	Panelboards	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 25 11	Busways	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 26 00	Power Distribution Units for Static Unin	1.5.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 27 26	Wiring Devices	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 29 11	Motor Controllers	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 29 21	Enclosed Switches and Circuit Breaker:	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements

26 33 53	Static Uninterruptible Power Supply	1.5.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 35 26	Harmonic Filters	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 36 23	Automatic Transfer Switches	1.5.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 43 13	Surge Protective Devices	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
26 51 00	Interior Lighting	1.4.A.	SUBMITTALS	Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements
27 05 11	Requirements for Communications Inst	1.7.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
27 05 11	Requirements for Communications Inst	1.7.B.	SUBMITTALS	Provide parts list including quantity of spare parts.

27 05 11	Requirements for Communications Inst	1.7.C.	SUBMITTALS	Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
27 05 11	Requirements for Communications Inst	1.7.D.	SUBMITTALS	Provide Source Quality Control Submittal
27 05 11	Requirements for Communications Inst	1.7.E.	SUBMITTALS	Installer Qualifications
27 05 11	Requirements for Communications Inst	1.7.F.	SUBMITTALS	Provide delegated design submittals (e.g. seismic support design).
27 05 11	Requirements for Communications Inst	1.7.G.	SUBMITTALS	Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August 2013.
27 05 11	Requirements for Communications Inst	1.7.H.	SUBMITTALS	Test Equipment List
27 05 11	Requirements for Communications Inst	1.7.I.	SUBMITTALS	Submittal Drawings
27 05 11	Requirements for Communications Inst	1.7.J.	SUBMITTALS	Provide sustainable design submittals.
27 05 11	Requirements for Communications Inst	1.7.K.	SUBMITTALS	Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

27 05 11	Requirements for Communications Inst	1.8.A.	CLOSEOUT SUBMITTALS	Provide following closeout submittals prior to project closeout date
27 05 11	Requirements for Communications Inst	1.8.B.	CLOSEOUT SUBMITTALS	Maintenance and Operation Manuals
27 05 11	Requirements for Communications Inst	1.8.C.	CLOSEOUT SUBMITTALS	Record Wiring Diagrams
27 05 11	Requirements for Communications Inst	1.8.D.	CLOSEOUT SUBMITTALS	Service Qualifications
27 05 11	Requirements for Communications Inst	1.9.A.	MAINTENANCE MATERIAL SUBMITTALS	After approval and prior to installation, furnish COR with the following
27 05 26	GROUNDING AND BONDING FOR COM	1.5.A.	SUBMITTALS	Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
27 05 26	GROUNDING AND BONDING FOR COM	1.5.B.	SUBMITTALS	Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
27 05 26	GROUNDING AND BONDING FOR COM	1.5.C.	SUBMITTALS	Provide riser diagram indicating location of communications grounding system connections indicating routing of grounding conductors.
27 05 26	GROUNDING AND BONDING FOR COM	1.5.D.	SUBMITTALS	Closeout Submittals
27 05 33	Raceways and Boxes for Communicatio	1.3.A.	SUBMITTALS	In accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following
27 05 33	Raceways and Boxes for Communicatio	1.3.B.	SUBMITTALS	Certification

27 08 00	Commissioning of Communications Sy	1.4.A.	CLOSEOUT SUBMITTALS	Refer to Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
27 08 00	Commissioning of Communications Sy	1.4.B.	CLOSEOUT SUBMITTALS	Pre-Functional Checklists
27 08 00	Commissioning of Communications Sy	1.4.C.	CLOSEOUT SUBMITTALS	Submit training agendas and trainer resumes in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
27 10 00	Control, Communication and Signal Wi	1.3.A.	SUBMITTALS	Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
27 10 00	Control, Communication and Signal Wi	1.3.B.	SUBMITTALS	Submit written certification from OEM
27 10 00	Control, Communication and Signal Wi	1.3.C.	SUBMITTALS	Identify environmental specifications on technical submittals; identify requirements for installation.
27 10 00	Control, Communication and Signal Wi	1.3.D.	SUBMITTALS	Power
27 10 00	Control, Communication and Signal Wi	1.3.E.	SUBMITTALS	Provide conduit size requirements.
27 10 00	Control, Communication and Signal Wi	1.3.F.	SUBMITTALS	Closeout Submittals
27 15 00	Communications Structured Cabling	1.3.A.	SUBMITTALS	In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, contractors will provide
27 15 00	Communications Structured Cabling	1.3.B.	SUBMITTALS	Certifications
27 15 00	Communications Structured Cabling	1.3.C.	SUBMITTALS	Closeout Submittal

27 51 16	Public Address and Mass Notification S 1.8.A.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	(Note
27 51 16	Public Address and Mass Notification S 1.8.B.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
27 51 16	Public Address and Mass Notification S 1.8.C.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
27 51 16	Public Address and Mass Notification S 1.8.D.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-005OP3B) will not review any submittal that does not have this list.

27 51 16	Public Address and Mass Notification S	1.8.E.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Provide four (4) copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C & D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
27 51 16	Public Address and Mass Notification S	1.8.F.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Provide interconnection methods, conduit (where not already installed), junction boxes (J-Boxes), cable, interface fixtures and equipment lists for the
27 51 16	Public Address and Mass Notification S	1.8.G.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Headend and each interface distribution cabinet layout drawing, as they are expected to be installed.
27 51 16	Public Address and Mass Notification S	1.8.H.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Equipment OEM technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
27 51 16	Public Address and Mass Notification S	1.8.I.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Engineering drawings of the System, showing calculated of expected signal levels at the headend input and output, each input and output distribution point, and signal level at each telecommunications outlet.
27 51 16	Public Address and Mass Notification S	1.8.J.	REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS	Surveys Required as a Part of The Technical Submittal
28 05 00	Common Work Results for Electronic S	1.6.A.	SUBMITTALS	Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

28 05 00	Common Work Results for Electronic S.	1.6.B.	SUBMITTALS	The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
28 05 00	Common Work Results for Electronic S.	1.6.C.	SUBMITTALS	Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
28 05 00	Common Work Results for Electronic S.	1.6.D.	SUBMITTALS	The submittals shall include the following

				Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows
28 05 00	Common Work Results for Electronic S	1.6.E.	SUBMITTALS	
28 05 00	Common Work Results for Electronic S	1.6.F.	SUBMITTALS	Group 1 Technical Data Package
28 05 00	Common Work Results for Electronic S	1.6.G.	SUBMITTALS	Group V Technical Data Package
28 05 00	Common Work Results for Electronic S	1.6.H.	SUBMITTALS	FIPS 201 Compliance Certificates
28 05 00	Common Work Results for Electronic S	1.6.I.	SUBMITTALS	Approvals will be based on complete submission of manuals together with shop drawings.

28 05 00	Common Work Results for Electronic S.	1.6.J.	SUBMITTALS	After approval and prior to installation, furnish the VA COR with one sample of each of the following
28 05 00	Common Work Results for Electronic S.	1.6.K.	SUBMITTALS	Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
28 05 00	Common Work Results for Electronic S.	1.6.L.	SUBMITTALS	In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.
28 05 13	Conductors and Cables for Electronic S	1.5.A.	SUBMITTALS	In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following
28 05 26	Grounding and Bonding for Electronic S	1.3.A.	SUBMITTALS	Submit in accordance with Section 27 05 11 – REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
28 05 26	Grounding and Bonding for Electronic S	1.3.B.	SUBMITTALS	Shop Drawings
28 05 26	Grounding and Bonding for Electronic S	1.3.C.	SUBMITTALS	Test Reports
28 05 26	Grounding and Bonding for Electronic S	1.3.D.	SUBMITTALS	Certifications

28 05 28.33	Conduits and Backboxes for Electronic	1.5.A.	SUBMITTALS	Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following
28 05 28.33	Conduits and Backboxes for Electronic	1.5.B.	SUBMITTALS	Shop Drawings
28 05 28.33	Conduits and Backboxes for Electronic	1.5.C.	SUBMITTALS	Certification
28 05 28.33	Conduits and Backboxes for Electronic	1.5.D.	SUBMITTALS	Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
28 05 28.33	Conduits and Backboxes for Electronic	1.5.E.	SUBMITTALS	Product Data
28 05 28.33	Conduits and Backboxes for Electronic	1.5.F.	SUBMITTALS	Coordination Drawings
28 05 28.33	Conduits and Backboxes for Electronic	1.5.G.	SUBMITTALS	Manufacturer Seismic Qualification Certification
28 05 28.33	Conduits and Backboxes for Electronic	1.5.H.	SUBMITTALS	Source quality-control test reports.

28 08 00	Commissioning of Electronic Safety an	1.6.A.	SUBMITTALS	The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
28 08 00	Commissioning of Electronic Safety an	1.6.B.	SUBMITTALS	The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
28 13 00	Physical Access Control Systems	1.4.A.	SUBMITTALS	Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
28 13 00	Physical Access Control Systems	1.4.B.	SUBMITTALS	Provide certificates of compliance with Section 1.3, Quality Assurance.

28 13 00	Physical Access Control Systems	1.4.C.	SUBMITTALS	Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
28 13 00	Physical Access Control Systems	1.4.D.	SUBMITTALS	Shop drawing and as-built packages shall include, but not be limited to
28 13 00	Physical Access Control Systems	1.4.E.	SUBMITTALS	Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process
28 13 00	Physical Access Control Systems	1.4.F.	SUBMITTALS	Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

28 13 00	Physical Access Control Systems	1.4.G.	SUBMITTALS	Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
28 13 00	Physical Access Control Systems	1.4.H.	SUBMITTALS	Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
28 13 00	Physical Access Control Systems	1.4.I.	SUBMITTALS	General
28 13 00	Physical Access Control Systems	1.4.J.	SUBMITTALS	Group 1 Technical Data Package
28 13 00	Physical Access Control Systems	1.4.K.	SUBMITTALS	Group II Technical Data Package
28 13 00	Physical Access Control Systems	1.4.L.	SUBMITTALS	Group III Technical Data Package
28 13 00	Physical Access Control Systems	1.4.M.	SUBMITTALS	Group IV Technical Data Package
28 13 00	Physical Access Control Systems	1.4.N.	SUBMITTALS	Group V Technical Data Package
28 13 00	Physical Access Control Systems	1.4.O.	SUBMITTALS	FIPS 201 Compliance Certificates
28 13 00	Physical Access Control Systems	1.4.P.	SUBMITTALS	Approvals will be based on complete submission of manuals together with shop drawings.

28 13 00	Physical Access Control Systems	1.4.Q.	SUBMITTALS	Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
28 23 00	Video Surveillance	1.5.A.	SUBMITTALS	Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples, and Section 02 41 00, Demolition Drawings.
28 23 00	Video Surveillance	1.5.B.	SUBMITTALS	Provide certificates of compliance with Section 1.4, Quality Assurance.
28 23 00	Video Surveillance	1.5.C.	SUBMITTALS	Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
28 23 00	Video Surveillance	1.5.D.	SUBMITTALS	Pre-installation design and as-built packages shall include, but not be limited to

28 23 00	Video Surveillance	1.5.E.	SUBMITTALS	Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process
28 23 00	Video Surveillance	1.5.F.	SUBMITTALS	Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
28 23 00	Video Surveillance	1.5.G.	SUBMITTALS	Submit manufacture’s certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

28 23 00	Video Surveillance	1.5.H.	SUBMITTALS	Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
28 31 00	Fire Detection and Alarm	1.4.A.	SUBMITTALS	General
28 31 00	Fire Detection and Alarm	1.4.B.	SUBMITTALS	Drawings
28 31 00	Fire Detection and Alarm	1.4.C.	SUBMITTALS	Manuals
28 31 00	Fire Detection and Alarm	1.4.D.	SUBMITTALS	Certifications

VHA Infection Control Risk Assessment
for Construction, Renovation and Maintenance

Introductory Information and Instructions

Use this template as a baseline for performing facility Infection Control Risk Assessments (ICRAs) for construction, renovation, and maintenance work (referred to as the "activity" in this document). The template provides minimum requirements for categorizing activity types and patient risk to determine the level of precautions needed to prevent infection risks. Facilities may customize this template to incorporate site-specific information and/or to add more stringent criteria.

This VHA ICRA template pertains specifically to infection prevention. It must be used if required by the VHA Pre-Construction Risk Assessment (PCRA) for the activity. *NOTE: The PCRA addresses other activity-related safety concerns (e.g., vibration, noise, hazardous materials) outside the scope of the ICRA.*

To complete the template:

1. Use **Table 1** to identify the category of the construction, renovation and/or maintenance activity.
2. Use **Table 2** to identify the areas affected by the activity.
3. Use **Table 3** to identify the overall patient risk category that will be affected by the activity.
4. Use **Table 4** to determine the level of infection prevention and control precautions needed for the activity.

Once all 4 steps above are completed: Refer to **Table 5** for the minimum required control measures for the level of infection prevention and control precautions needed for the activity. Refer to **Table 6** for the minimum infection prevention and control measures required on completion of the activity.

PERMIT: See the last page of this document for a fillable permit form to be used for posting at the activity site as needed.

Table 1 - Construction, Renovation, and/or Maintenance Activity Category

NOTE: *If any of the bulleted criteria in a higher activity category pertains to the work that will be done (even if the other criteria are in a lower category), use the higher activity category for the VHA ICRA.*

Activity Category determined from Table 1 (*A, B, C, or D*): ☐

Category A	**Inspection and/or facility upkeep generally defined as follows**: • Work can be completed in a single shift, not to exceed 10 hours. • Patients and/or employees may be in the area depending on the activity. • Work that does not create dust or debris. • Removal of ceiling tile or access to mechanical or electrical chase for visual inspection limited to 1 tile per 50 square feet with limited exposure time (not to exceed an hour for each tile) within the shift. • Minor interior updates (e.g., replacing floor or ceiling tiles, carpentry work to include hanging signage, and painting without sanding) that do not create dust or debris. • Limited building system maintenance such as basic plumbing on potable systems (e.g., faucet replacement) or basic electrical work such as replacement of light bulbs, receptacles, or switches.
Category B	**General maintenance and repair work generally defined as follows:** • Prolonged inspection and work that may take longer than a single shift but not exceeding a week. • Patients and employees are not to be in the area until activity is completed. • Work that creates minimal dust and debris.

	• Interior finish or surface repairs, updates, or modifications such as repair of firewalls and barriers, and new flooring that produces minimal dust and debris. Controlled sanding activities (e.g., wet or dry sanding) that produce minimal dust and debris. • Plumbing work such as installation or replacement of a single fixture or piping for a single fixture. Any work on sanitary plumbing including snaking of drains. • Electrical work such as installation of cabling/wiring/conduit for a single device, installation of new device such as a light fixture that produces minimal dust and debris. • Air Handler and/or fan shutdown/startup and HVAC work such as replacement of a single diffuser, single terminal unit or a single device that produces minimal dust and debris.
Category C	**Small-scale construction, renovation, or maintenance generally defined as follows**: • Work requiring longer than a single week to complete but not exceeding 6 months. • Patients and employees are not to be in the area until activity is completed. • Demolition/removal of preexisting floor covering, casework, lay-in ceiling, or other architectural elements. • Demolition/removal of more than 32 ft^2 of drywall/framing, hard ceilings, and doors/framing and minimal infrastructure such as electrical circuits and branch piping. • Installation of new walls, ceilings and doors including framing, drywall/plaster and associated work. • Plumbing work such as the installation of new sinks, showers and toilets and associated plumbing. • Shut down of sections of potable water systems. • Electrical work such as installation of conduit and wire for lighting, receptacles and switches for an area, the installation of conduit and wire for new devices such as terminal units, fans etc. • Modification of existing fire alarm and suppression systems. • Mechanical work such as the installation of ductwork, diffusers, and terminal units for an area.

Category D	**Large-scale construction, renovation, or maintenance generally defined as follows**:
	• Work exceeding 6 months in duration.
	• Patients and employees are not to be in the area until activity is completed.
	• Large-scale demolition of building components and infrastructure including removal of multiple doors, walls, framing, ceilings, flooring, piping, electrical and HVAC.
	• The installation building components such as new walls, ceilings and doors including framing, drywall and associated plaster work.
	• Plumbing work such as the installation of:
	  ○ new medical gas systems,
	  ○ steam/heating hot water, condensate systems,
	  ○ multiple sinks, showers and toilets including associated plumbing.
	• Shutdown of potable water, steam/heating hot water, condensate, and medical gas systems.
	• Electrical work such as installation of electrical feeders, distribution panels, conduit and wire for lighting, receptacles and switches for an area, the installation of conduit and wire for new devices such as terminal units, fans etc.
	• Installation of fire alarm and suppression systems.
	• Electrical shutdown of multiple panels.
	• Mechanical work such as the installation of air handling equipment, associated ductwork, diffusers, heat exchangers, terminal units and controls.

Table 2 - Affected Area Assessment

Identify the areas and associated patients that will be affected by the construction/renovation/maintenance activity (see the Figure for a visual representation of adjacent affected areas).

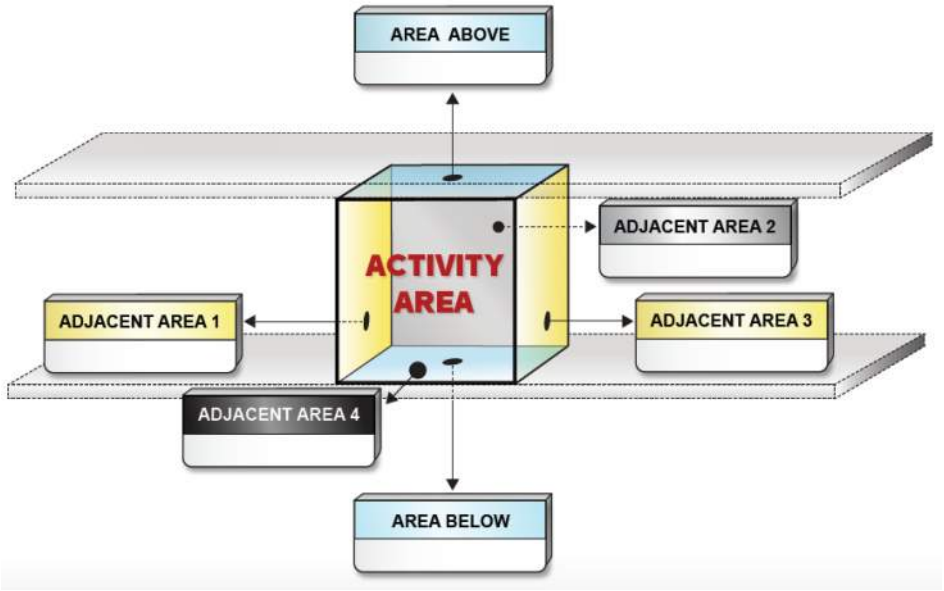

Figure: Isometric drawing of affected area assessment

Area	**Service(s)/Type(s) of Area(s)** *(e.g., OR, Unit/Ward, Sterile Processing, Administrative, etc.)**	**Point of Contact (POC)**	**POC Contact Information**
Activity Area**			
Area Above			
Area Below			
Adjacent Area 1			
Adjacent Area 2			
Adjacent Area 3			
Adjacent Area 4			

* There may be more than one Service/type of area for each row. List all.

** List the area(s) in which the construction/renovation/maintenance activity will occur. ***NOTE: When the Activity Category is B, C, or D, the control measures are determined by the Patient Risk in the adjacent affected areas.***

VHA Infection Control Risk Assessment
for Construction, Renovation and Maintenance

Table 3 - Patient Risk Category

Using Table 3, identify the patient risk category for each area listed in Table 2. Of the patient risk categories identified, select the one with the greatest risk as the overall Patient Risk Category for the activity.

Overall Patient Risk Category determined from Table 3 (*Low, Medium, High, or Highest*): ____

Low Risk	Medium Risk	High Risk	Highest Risk
Non-patient care areas such as:	Patient care support areas such as:	Patient care areas such as:	Procedural, invasive, sterile support and highly compromised patient care areas such as:
• Public hallways and gathering areas not in clinical areas • Office areas not in clinical areas • Breakrooms not in clinical areas • Bathrooms or locker rooms not in clinical areas • Mechanical/electrical rooms not in clinical areas	• Waiting areas • Clinical engineering (biomedical) • Materials management • Sterile processing department – dirty side • Kitchen, cafeteria, gift shop, coffee shop, and food kiosks	• Patient care rooms and areas, including spinal cord injury units • All acute care units, including mental health • All outpatient units and clinics • Emergency department • Community Living Centers, domiciliaries, and transitional residences • Employee health • Pharmacy – general work zone • Medication rooms and clean utility rooms • Imaging suites – diagnostic imaging • Laboratory	• All transplant units • All intensive care units • All oncology units and chemotherapy/infusion centers • OR theaters and restricted areas • Hemodialysis units • Procedural rooms* • Pharmacy compounding area • Sterile processing department – clean side • Transfusion services • Imaging suites – interventional imaging • Dedicated isolation wards/units for infectious diseases

***** Procedural Rooms are designated for the performance of patient care activities that may require high-level disinfected or sterile instruments and some environmental controls but is not required to be performed with the environmental controls of an operating room (OR). The room is intended for procedures that are performed in an aseptic surgical field and penetrates the protective surfaces of a patient's body (e.g., subcutaneous tissue, mucous membranes, cornea) or entry into or opening of a sterile body cavity. Examples of these spaces include, and are not limited to, Cardiac Catheterization Suites, Electrophysiology Suites, Endovascular/GI Suites, Angio Suites and other spaces which may have high risk patient populations.

Table 4 - Level of Infection Prevention and Control Precautions

Match the Overall Patient Risk Category (*Low, Medium, High, Highest*) determined from Table 3 with the planned Construction/Renovation/Maintenance Activity Category (*A, B, C, D*) from Table 1 to determine the minimum Level of Infection Prevention and Control Precautions (*I, II, III, or IV*) using Table 4 below.

Level of Precautions determined from Table 4 (*I, II, III, or IV*): ☐

Patient Risk Category	**Activity Category**			
	A	**B**	**C**	**D**
Low Risk	I	II	II	III
Medium Risk	I	II	III	IV
High Risk	I	II	IV	IV
Highest Risk	II	III	IV	IV

An infection prevention and control permit is required for Level III and Level IV. Consult with Infection Prevention and Control for Level I and Level II.

Table 5 - Required Infection Prevention and Control Measures, by Level of Precautions

Controls defined below for the Level of Precautions identified for the activity must be in place before the activity begins and maintained until work is completed and the area is activated. Control measures for each Precaution Level must also include the control measures in the preceding Level(s).

As the activity progresses, a full re-evaluation of remaining activity type and patient risk is required prior to downgrading the Level of Precautions.

Level of Precautions	**Control Measures**
Level I	1. Perform work activity in a manner that does not create dust. 2. Immediately replace any ceiling tile, close access panels, etc., upon completion of work. 3. Any materials and equipment being brought into the facility must be free of contaminants and loose material.
Level II	**All control measures in Level I and the following:** 1. Provide active means to control airborne dust from dispersing into occupied areas and/or water mist surface to control dust (e.g., Mobile Dust Containment Cart or some other system). 2. Ensure worker clothing is clean and free of visible dust before leaving the work area. 3. Remove or isolate air diffusers (supply and return) to protect the HVAC system from dust and reduce air turbulence. Rebalance system to address diffuser isolation.

	4. When the work involves or impacts potable water systems including stagnation due to reduced usage, the piping shall be flushed twice a week or isolated from the main system. 5. Seal doors to prevent dust migration. 6. Contain all trash and debris in the work area. Perform daily cleaning and disposal of trash (covered) from work area using an identified exit route. 7. Any equipment, tools, or materials removed from the work area must be in sealed containers and/or cleaned of dust and debris prior to removal from the area. 8. Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. 9. Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled. 10. Maintain clean surroundings when area is not contained by damp mopping or HEPA vacuuming surfaces at least daily.
Level III	**All control measures in Levels I and II and the following:** 1. Ensure availability of equipment for cleaning hands. 2. Construct and complete critical barriers meeting NFPA 241 requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above. 3. All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to floor and ceiling (or floor/roof deck above) and secure from movement or damage. 4. Seal all penetrations in containment barriers, including floors and ceiling, using approved materials (UL schedule firestop if applicable for barrier type). 5. Maintain .01 inches /water gauge negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors, or comply with the alternative method outlined in Appendix A of this document. These control measures must be maintained continuously 24/7 for the duration of the project. HEPA filtered exhaust if discharged directly to the outdoors must be at a distance of 25 feet or greater from entrances, air intakes and operable windows. Exhausting discharged air into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is prohibited. 6. Install a differential pressure sensing device (e.g., magnehelic, manometer, or digital monitoring) on exterior of work containment to continually monitor and document negative pressurization. The “ball in the wall” or similar apparatus are not acceptable.
Level IV	**All control measures in Levels I, II and III and the following:** 1. Barriers must be hard barriers unless temporary to install final barrier. 2. Containment must include an anteroom to ensure pressure control. Anteroom must be large enough for equipment staging, cart cleaning, workers’ PPE and cleaning. 3. Worker clothing and/or PPE must be removed or clean and free of visible dust before leaving the work area anteroom. HEPA vacuuming of clothing or use of cover suits is acceptable. 4. Workers must wear shoe covers or have a method to clean shoes in anteroom. Shoe covers must be removed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be changed immediately.

Table 6 - Minimum Infection Prevention and Control Measures Required Upon Completion of the Activity

Controls defined below shall be completed upon completion of the activity and inspected prior to terminating measures defined in Table 5.

Level of Precautions	Measures
Levels I - II	**Cleaning:** 1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. 2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. **HVAC Systems:** 1. Remove isolation of HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational. 2. Verify the HVAC systems meet original airflow and air exchange design specifications. **Water systems:** 1. Until the potable water system is activated and in use, flushing shall continue at least twice per week in accordance with VHA Directive 1061.
Levels III - IV	Construction areas must be inspected by an infection preventionist and engineering representative (and others as determined by the facility) for final activity/project close out and removal of infection prevention and control measures. **Work Area Cleaning:** 1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. 2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. **Removal of Critical Barriers:** 1. Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed. Additional cleaning may be needed after removal of barrier. 2. All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers: i. Carefully remove screws and painter tape. ii. If dust will be generated during screw removal, use hand-held HEPA vacuum. iii. Drywall cutting is prohibited during removal process. iv. Clean all stud tracks with HEPA vacuum before removing outer hard barrier. v. Use a plastic barrier to enclose area if dust could be generated. **Negative Air Requirements:** 1. The use of negative air must be designed to remove contaminants from the work area. 2. Negative air devices (fans, filters, monitoring and documentation equipment) must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers. **HVAC systems:** 1. Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed. 2. Verify that HVAC systems are clean and operational. 3. Verify and document through a TAB the HVAC systems meets original airflow and air exchange design specifications. **Water systems:** 1. Until the potable water system is activated and in use, flushing shall continue at least twice per week in accordance with VHA Directive 1061.

Infection Prevention and Control Construction/Renovation/Maintenance Permit

This page must be posted at the entrance to the project area for Level III and Level IV activities.

Unique permit number:			
Location of construction/renovation/maintenance			
Project manager		Project start date	
Contact phone number		Completion date	
Contractor		Permit expiration date	

Activity Category (*A, B, C, or D*)		Overall Patient Risk Category (*Low, Medium, High, or Highest*)		Level of Infection Prevention and Control Precautions (*I, II, III, or IV*)	

Level of Precautions	**Control measures to be in place for the duration of the activity** *(Check the box for the activity's Level of Precautions to indicate the Control Measures)*
Level I ☐	1. Perform work activity in a manner that does not create dust. 2. Immediately replace any ceiling tile, close access panels, etc., upon completion of work. 3. Any materials and equipment being brought into the facility must be free of contaminants and loose material.
Level II ☐	**All control measures in Level I and the following:** 1. Provide active means to control airborne dust from dispersing into occupied areas and/or water mist surface to control dust (e.g., Mobile Dust Containment Cart or some other system). 2. Ensure worker clothing is clean and free of visible dust before leaving the work area. 3. Remove or isolate air diffusers (supply and return) to protect the HVAC system from dust and reduce air turbulence. Rebalance system to address diffuser isolation. 4. When the work involves or impacts potable water systems including stagnation due to reduced usage, the piping shall be flushed twice a week or isolated from the main system 5. Seal doors, to prevent dust migration. 6. Contain all trash and debris in the work area. Perform daily cleaning and disposal of trash (covered) from work area using an identified exit route. 7. Any equipment, tools, or materials removed from the work area must be in sealed containers and/or cleaned of dust and debris prior to removal from the area. 8. Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. 9. Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled. 10. Maintain clean surroundings when area is not contained by damp mopping or HEPA vacuuming surfaces at least daily.
Level III ☐	**All control measures in Levels I and II and the following:** 1. Ensure availability of equipment for cleaning hands. 2. Construct and complete critical barriers meeting NFPA 241 requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above. 3. All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to floor and ceiling (or floor/roof deck above) and secure from movement or damage. 4. Seal all penetrations in containment barriers, including floors and ceiling, using approved materials (UL schedule firestop if applicable for barrier type). 5. Maintain .01 inches /water gauge negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors, or comply with the alternative method outline in Appendix A of the VHA ICRA template. These control measures must be maintained continuously 24/7 for the duration of the project. Exhausting discharged air into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is prohibited. **Check box to indicate exhaust method:** Exterior ☐ Alternative Interior Method ☐ 6. Install a differential pressure sensing device (e.g., magnehelic, manometer, or digital monitoring) on exterior of work containment to continually monitor and document negative pressurization. The "ball in the wall" or similar apparatus are not acceptable.
Level IV ☐	**All control measures in Levels I, II and III and the following:** 1. Barriers must be hard barriers unless temporary to install final barrier. 2. Containment must include an anteroom to ensure pressure control, Anteroom must be large enough for equipment staging, cart cleaning, workers' PPE and cleaning. 3. Worker clothing and/or PPE must be removed or clean and free of visible dust before leaving the work area anteroom. HEPA vacuuming of clothing or use of cover suits is acceptable. 4. Workers must wear shoe covers or have a method to clean shoes in anteroom Shoe covers must be removed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be changed immediately.

Additional requirements:			
Project Manager signature		Date	
Infection Preventionist signature		Date	

Appendix A: Alternative To Outdoor Exhaust Requirements

This Appendix provides an equivalent ICRA control measure to requirements detailed in this VHA ICRA template (Table 5 Level III, item 5) that would allow interior construction space exhaust.

Interior Construction Space Exhaust:

If the facility is not able to exhaust to the building exterior, the Healthcare Environment and Facilities program office has identified an alternate industry-recognized standard interior exhaust procedure that is accepted as providing an equivalent level of infection prevention and control (IPC), and safety. The alternate interior exhaust procedure is implemented by completing the following:

a. If exhaust is directed indoors, then the system must be HEPA filtered. Prior to start of work, including assembly of the ICRA barriers, initial baseline air sampling measurements for particulate levels must be taken in the planned area of discharge. Once containment is erected and completed, HEPA filtration must then be verified by particulate measurement, using a particle counter with multi-channel capabilities to measure down to 0.3 microns, to confirm that the discharge of the HEPA unit does not exceed the baseline particulate count of the area to which the exhaust is directed. Verification must continue at least three times per day (once every 8 hours), 7 days per week, during the use of the negative air machine and HEPA filter. Any exceedance must trigger a work stoppage and an immediate response and resolution. All particulate measurements, including the baseline measurement, must be documented and retrievable.
b. To accommodate the sampling, the negative air pressure machine must be fitted with a 2 ft section of rigid ductwork at the discharge. The sample port for monitoring must be in the rigid ductwork section.
c. Vapor generating processes must be assessed and appropriate filtration must be installed to mitigate transmission to the facility.
d. Engineering must do a complete flow and pressure analysis and document the area to which the air is being discharged to ensure the flow and pressure relationships in that area are not being adversely impacted by the additional flow. Ideally, this is done as part of the construction package to ensure the design is implementable and no additional HVAC changes are required to accommodate the exhaust from the negative air equipment.
e. Install device on exterior of work containment to continually monitor negative pressurization. To ensure proper pressure is continuously maintained, the device(s) shall have a visual pressure indicator, data collection and alarm.
f. Exhaust must be directed to Low Risk areas as defined in Table 3 in this VHA ICRA template. Ideally this discharge must be located so as not to impinge on high traffic areas or create a nuisance with noise or excessive airflow.
   NOTE: *Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is not acceptable.*

VHA Pre-Construction Risk Assessment (PCRA)

PCRA Introductory Information and Instructions

Use this template as a baseline for performing facility Pre-Construction Risk Assessments (PCRA) for Construction, Renovation, and Maintenance work (referred to as the "activity" in this document). The template provides minimum requirements for categorizing activity type(s) and safety risk to determine the level of precautions needed to prevent impact related to Construction, Renovation and Maintenance on patients, employees, and contractors.

Ensure that the activity statement of work and any drawings available are used for the PCRA assessment and included in the project file with the completed PCRA.

Communication and coordination of all types of activity with affected areas are to be included among the control measures. The development of communication and coordination plans must begin during the activity planning phase.

Facilities may customize this template to incorporate site-specific information and requirements.

NOTE: *This VHA PCRA template pertains specifically to non-infection-related safety for Construction, Renovation, and Maintenance activities. It must be used in conjunction with the VHA Infection Control Risk Assessment (ICRA) for the activity, if required, which specifically addresses infection risks outside the scope of this PCRA.*

PERMIT: See the last page of this document for a fillable permit form to be used for posting at the activity site.

Activity Location:	2B-105
Activity Name, Number, and/or Brief Description:	618-26-701 EHRM Infrastructure Upgrades Tier 2 - Data Center Upgrades

Table 1 - Construction, Renovation, and/or Maintenance Activity Type and Control Measures

NOTE: *If any of the bulleted criteria in a higher activity type pertains to the work that will be done (even if the other criteria are in a lower type), use the higher activity type for the VHA PCRA.*

Controls defined in Table 1 for the activity must be in place before the activity begins and maintained until work is completed and the area is activated. Control measures for each activity must also include the control measures in the preceding row(s).

As the activity progresses, a full re-evaluation of remaining activity type and risk is required prior to changing the level of control measures.

Activity Type determined from Table 1: Large Scale

Activity Type and Description	Control Measures
Inspection/upkeep generally defined as follows: • Work can be completed in a single shift, not to exceed 10 hours. • Patients, employees and/or visitors may be in the area depending on the activity. • Work that does not create dust or debris. • Work that does not create vapors or fumes. • Removal of ceiling tile or access to mechanical or electrical chase for visual inspection that will not impair fire safety systems and are limited to 1 tile per 50 square feet with limited	1. Immediately replace any ceiling tile, close access panels, etc., upon completion of work. 2. Site visits of construction area are required weekly by member of multi-disciplinary team. Site visits will be documented on standard checklist. 3. Site specific safety plan, task hazard analysis, and hazard communication required to be provided by the contractor and approved where a contact is in place. For internal work the

VHA Pre-Construction Risk Assessment (PCRA)

exposure time (not to exceed an hour for each tile) within the shift. • Minor interior updates (e.g., replacing floor or ceiling tiles, carpentry work to include hanging signage, and painting with hand tools) that do not create vibration or noise. • Limited building system maintenance that does not require Lock Out Tag Out (LOTO) such as plumbing on potable systems limited to faucet replacement, steam trap replacement etc. and electrical work such as replacement of bulbs, receptacles, or switches.	shop involved must work with Safety to ensure proper precautions are in place. 4. Must address identified hazards and controls that will be implemented to ensure minimal impact to patients, employees, contractors and facility. 5. Communication and coordination plan for all affected areas

Small scale Construction, Renovation and general maintenance/repair work, generally defined as follows:
• Prolonged work that may take longer than a single shift but not exceeding six months.
• Patients and employees are not to be in the area until activity is completed.
• Work that creates some noise and vibration due to power tool use.
• Selective demolition/removal of preexisting floor covering, casework, lay-in ceiling, or other architectural elements that may
  o disturb asbestos, lead or silica
  o create the potential for falling objects
  o create vibration and/or noise in excess of 80 dB(A) in surrounding areas.
  o cause penetrations in fire or smoke barrier
• Plumbing work such as the installation of new sinks, showers and toilets and associated plumbing that requires utility outages or work on the steam system that may require:
  o LOTO
  o The use of compressed gas cylinders
• Electrical work such as installation of conduit and wire for lighting, receptacles and switches for an area, the installation of conduit and wire for new devices such as terminal units, fans etc. Electrical work such as installation of cabling/wiring/conduit for a single device, installation of new device such as a light fixture that require LOTO.
• Air Handler and/or fan shutdown/startup and HVAC work such as replacement of a single diffuser, single terminal unit, a single device and the installation of ductwork, diffusers, and terminal units for an area that may require:
  o Work on ladders
  o Rigging, hoisting or lifting of equipment or materials overhead
• Modification of existing fire alarm and suppression systems requiring system outages and ILSMs or obstruction of exits and or impact on corridors.
• Architectural, structural, or any other work that may cause vapors or fumes such as:
  o Roofing work
  o Flooring work
  o Painting or other large-scale use of such substances.
	All control measures in the row above and the following:
	1. Hazard communication chemical inventory required to be provided by the contractor and approved.
	2. Where construction, Renovation and maintenance are done in an accredited facility, and ILSM assessment is required to be done and ILSMs put into place in accordance with TJC LS.01.02.01 and the local facility policy including Fire watch if necessary. Staff is trained and the ILSM is verified regularly
	3. Hot Work or burn permits in place and staff trained
	4. LOTO procedures in place and staff trained on their use
	5. Site visits will be reviewed using the criteria in standardized guide.
	6. Daily inspections of the site are to be conducted by the General Contractor or shop supervisor and documented on their daily log.

Large-scale construction, renovation, or maintenance generally defined as follows: • Work exceeding 6 months in duration. • Patients and employees are not to be in the area until activity is completed.	**All control measures in the two rows above and the following Activity Hazard Analyses and Control Plans (check all that apply):** 1. Excavation safety plan in place ☐ 2. Dust control plan in place ⬓

• Excavation or heavy equipment use taking place
  o Dig safe required utility location
  o Trench safety
  o Dust control plan
  o Equipment exhaust, Noise, Vibration
• Confined space entry required (permit required or not)
• Requires crane work
  o General crane work
  o Lift over buildings
• Includes elevated work
  o Roof work, fall protection
  o Window work, scaffolding and fall protection
  o Odor control
• Welding, cutting or use of torches requiring burn permits
• Demolition of building components and infrastructure including removal of multiple doors, walls, framing, ceilings, flooring, piping, electrical and HVAC that may
  o require asbestos, lead or silica abatement
  o create the potential for falling objects
  o create vibration and/or noise in excess of 90 dB(A) in surrounding areas.
  o cause breaches to fire or smoke barrier
• The installation building components such as new walls, ceilings and doors including framing, drywall and associated plaster work that requires transport of significant materials through building and up elevators i.e., weight limits of floors and elevators
• Plumbing work requiring LOTO and system shutdown and startup such as the installation of:
  o new medical gas systems,
  o steam/heating hot water, condensate systems,
  o Potable water and sanitary drainage, multiple sinks, showers and toilets including associated plumbing.
• Electrical work such as installation of electrical feeders, distribution panels, conduit and wire for lighting, receptacles and switches for an area, the installation of conduit and wire for new devices such as terminal units, fans etc. requiring LOTO and system isolation.
• Installation of fire alarm and suppression systems requiring outages of those systems and ILSMs or closure of exits/corridors
• Mechanical work such as the installation of air handling equipment, associated ductwork, diffusers, heat exchangers, terminal units and controls requiring lifting and support of equipment and systems.
	3. Pollution prevention plan in place ☐
	4. Dig safe paper work in place ☐
	5. Crane lift plan in place ☐
	  a. Crane placement
	  b. Crane swing
	  c. Crane load evaluation
	6. Fall protection plan in place and staff trained ☐
	7. Confined entry plan in place and staff trained ☐

Table 2. Affected Adjacent Area Assessment

In addition to the minimum precautions noted above for the Activity Type, it is critical that the activity be coordinated with the areas adjacent to the activity to ensure operations in those areas are not disrupted or impacted. List the adjacent areas in Table 2 below and develop activity-specific coordination plans and associated communication plans with each area to address activity work that could impact or disrupt the operation of the areas, in general as follows:

- If adjacent area is **vacant** (e.g., work outside, construction of new building, etc.):
  - Coordination is typically not necessary other than potentially traffic flow and pedestrian access.

VHA Pre-Construction Risk Assessment (PCRA)

- If adjacent area is **non-continuously occupied** (e.g., areas where outpatient care is provided, employee health, etc.):
    - Develop a list of activities that will potentially impact or disrupt the operation of the area (e.g., work involving noise, vibration or exit obstruction) and meet with POC to coordinate execution of work in a way that mitigates the impact (e.g., conduct work after hours).
- If adjacent area is **occupied continuously** (e.g., areas where inpatient care is provided, residential areas such as Community Living Centers, etc.):
    - Develop a list of activities that will potentially impact or disrupt the operation of the area (e.g., work involving noise, vibration or exit obstruction) and meet with POC to coordinate execution of work in a way that mitigates the impact (e.g., move affected party temporarily).

Area	**Service(s)/Type(s) of Area(s)** *(e.g., OR, Unit/Ward, Sterile Processing, Administrative, etc)**	**Point of Contact (POC)**	**POC Contact Information**	**Construction plan communicated to POC?**
Activity Area**	Server Rm 2B-105	Josh Geurts	Joshua.Geurts@va.gov	yes
Area Above	3A CPAP	Josh Zacher	Joshua.Zacher@va.gov	no
Area Below	1A Canteen	Canteen Mgr		no
Adjacent Area 1	2G Social Work	Jennifer Radtke	Jennifer.Radtke@va.gov	no
Adjacent Area 2	2B Misc Offices			no
Adjacent Area 3	Corridor	Tim Filzen	Timothy.Filzen@va.gov	yes
Adjacent Area 4	N/A			

* There may be more than one Service/type of area for each row. List all. The information entered on this table must be used in the ICRA if required.

** List the area(s) in which the construction/renovation/maintenance activity will occur.

Infection Control Risk Assessment (ICRA)

Consult with Infection Prevention and Control regarding the assessment of potential patient infection risks associated with the activity and the need for control measures. For example, activities such as a boiler plant project and/or facility steam shutdown, if properly planned, should have minimal to no patient infection risk impacts and likely not to require an ICRA. See VHA Directive 7715 and the VHA ICRA Template for more information.

Is an ICRA required for the Activity? Yes ☐ No ☐

Pre-Construction Risk Assessment (PCRA) Permit

This page must be posted at the entrance to the project area, or other designated area

Unique permit number: 618-26-701			
Location and brief description of construction/renovation/maintenance	Update the existing MCR space to support the ongoing EHRM project		
Project manager	Tim Filzen	Project start date	01/15/2026
Contact phone number	763-300-3233	Completion date	07/17/2026
Contractor or lead shop	The Richard Group	Permit expiration date	

Activity Type *Inspection/Upkeep, Small-scale, or Large-scale)*	Large Scale

Activity Type	**Control measures to be in place for the duration of the activity** *(Check the box for the Activity Type to indicate the Control Measures)*
Inspection/Upkeep ☐	1. Immediately replace any ceiling tile, close access panels, etc., upon completion of work. 2. Site visits of construction area are required weekly by member of multi-disciplinary team. Site visits will be documented on standard checklist. 3. Site specific safety plan, task hazard analysis, and hazard communication required to be provided by the contractor and approved. 4. Must address identified hazards and controls that will be implemented to ensure minimal impact patients, employees, contractors and facility. 5. Communication and coordination plan for all affected areas
Small-scale ☐	**All control measures in the row above and the following:** 1. Hazard communication chemical inventory required to be provided by the contractor and approved. 2. ILSMs in place and staff trained on situation 3. Hot Work or burn permits in place and staff trained 4. LOTO procedures in place and staff trained on their use 5. Site visits will be reviewed using the criteria in standardized guide. 6. Daily inspections of the site are to be conducted by the General Contractor and documented on their daily log.
Large-scale ☑	**All control measures in both rows above and the following Activity Hazard Analyses and Control Plans as applicable (check all that apply):** 1. Excavation safety plan in place ☐ 2. Dust control plan in place ☐ 3. Pollution prevention plan in place ☐ 4. Dig safe paperwork in place ☐ 5. Crane lift plan in place ☐ a. Crane placement b. Crane swing c. Crane load evaluation 6. Fall protection plan in place and staff trained ☐ 7. Confined entry plan in place and staff trained ☐

Additional requirements:

Is an Infection Control Risk Assessment (ICRA) required for the Activity? Yes ☐ No ☐

Infection Prevention and Control signature:
Date:

Project Manager signature		Date	
Safety Officer signature		Date	
Chair, Construction Safety Committee signature		Date	

*The location of all Activity Hazard Analyses and Control Plans (excavation, dust, pollution, etc.) as applicable shall be identified on this permit and shall be made available to all workers on the job.

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

1.1 DESCRIPTION

A. The Contractor will develop a fully Resource loaded (cost) Network Analysis System (NAS) plan/diagram and computer generated schedule demonstrating fulfillment of the entire contract requirements, will keep the plan and computer generated schedule up-to-date in accordance with the specification requirements of this section and will utilize the plan for scheduling, coordinating, mitigating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers) and verification of every Periodic Progress Schedule Updates and Progress Payment Submission of the work under this contract.

1.2 PROJECT SCHEDULER

A. Designate a qualified 3rd-party scheduling consultant who will develop and maintain the project schedule.

B. The scheduling consultant must have five (5) years of experience as a lead project scheduler or previous scheduling experience on at least three (3) projects of similar size and scope.

C. The scheduling consultant must be prepared to discuss, in detail, the proposed sequence of work and methods of operation, and how that information will be communicated through the progress schedule at the preconstruction meeting.

D. The scheduling consultant is required to attend a monthly schedule meeting and make site visits to prepare, develop, and maintain the progress schedules.

1.3 SUBMITTALS

A. Initial Schedule:

1. Submit an initial schedule within 7 calendar days after Notice to Proceed (NTP).
   a. Include full schedule details for the first 60 calendar days of work starting on the NTP date and show the schedule ending on or before the Contract Completion Date (CCD).
   b. Provide a summary bar chart schedule (acceptable formats include, but are not limited to, Microsoft Excel, Microsoft Project, Oracle Primavera P6, and Gantt Chart).

c. Show the proposed sequence, durations, early and late start dates for major work activities.

d. Show the proposed calendar dates for starting and finishing initial contract activities including, but not limited to, set up of construction site, site layouts, travel routes, waste, and staffing areas.

2. Conduct a schedule review meeting with the Government within 14 calendar days after NTP. At this meeting, plan to discuss the proposed schedule for the entire project, including both the detailed first 60-day period covered by the initial schedule as well as the following summary schedule. If deviations to the staging, phasing, or sequencing required by the contract documents are proposed, be prepared to discuss these deviations.

3. The Government will respond by approving the initial schedule, rejecting the schedule and identifying the reason for rejection, or by asking the contractor for additional information clarifying the proposed schedule activities and timelines.

4. The Government will use the approved initial schedule to monitor progress until the baseline schedule is approved.

5. The Government may withhold progress payments until the initial schedule is approved.

B. Schedule of Costs.

1. No more than 30 calendar days after receipt of the Notice to Proceed, prepare and submit a schedule of costs to the Government for review, in accordance with the technical and schedule submittal requirements listed in this is specification.

2. The approved Schedule of Costs will serve as a tool in addition to the required monthly schedule update to determine progress payments to the Contractor for work completed.

3. The costs shown on the Schedule of Costs must represent true costs and the work activities/events match the project schedule work activities/events. The VA Contracting Officers Representative (VA COR) may require the Contractor to submit its original estimate sheets or other supporting documentation to substantiate the detailed makeup of the cost schedule.

4. The total costs of all work activities/events listed on the Schedule of Costs must equal the total contract price. The breakdown must

include all line items specified in the contract and work activities shown on the schedule.

5. The Contractor is responsible for regularly updating the Schedule of Costs to reflect any approved changes to the contract scope or cost structure. Updates must be submitted for approval to the Contracting Officer to ensure continued accuracy and compliance with contract requirements.
6. Failure to submit or maintain an accurate and approved Schedule of Costs may result in delayed progress payments and potential penalties as outlined in the contract agreement.
7. All documentation related to the Schedule of Costs, including original estimate sheets and cost substantiation documents, must be maintained and made available for review upon request by the Contracting Officer or VA COR.

C. Baseline Schedule.

1. No more than 30 calendar days after approval of the initial schedule, prepare and submit a baseline schedule to the Government for review, in accordance with the technical and schedule submittal requirements listed in this specification.
2. The Government will respond by accepting the baseline schedule, rejecting the schedule and identifying the reason for rejection, or by asking for more information.
3. Address the reasons for rejection or provide the information requested and resubmit the revised baseline schedule no more than 10 calendar days after the Government’s response.
4. The Government may withhold progress payments until the baseline schedule is approved.
5. No stored material work activities will be shown or approved be on the baseline schedule.
6. The Baseline Schedule Critical Path of the project shall be limited to:
   a. No more than 20% of the work activities shall be on the critical and near-critical path(s). Critical path is defined as activities with zero (0) day total float. Near-Critical path(s) is defined as activities with one (1) to twenty (20) days of total float.
   b. Multiple Critical paths will not be allowed.
7. The Baseline Schedule shall contain sufficient detail such that no more than 5% of work activities have durations exceeding 20 work

days, in accordance with DCMA 14-point Schedule Assessment Guidelines.

D. Monthly Schedule Update.

1. Prepare and submit a monthly schedule update to the Government that depicts the status of the project as of the end of the month, in accordance with the technical and schedule submittal requirements listed in this specification.
2. The update must reflect a new data date, work performed up to, but not including, the new data date, and the plan for completing the project.
3. Submit the schedule update by the first Monday of the following month.
4. The Government may withhold progress payments until the monthly schedule update is approved.
5. Each monthly schedule update must be submitted with the associated schedule log.

E. Revised Schedule.

1. The Government has the right to request a revised schedule.
2. Circumstances leading to such a request include, but are not limited to:
   a. A projected or forecasted delay to scheduled interim or project completion dates.
   b. A significant difference between the actual sequence or duration of work and that depicted in the schedule.
3. Prepare and submit the revised schedule no more than 10 calendar days after the Government’s request in accordance with the technical and schedule submittal requirements listed in this specification.
4. The Government will respond by accepting the revised schedule, rejecting the schedule and identifying the reasons for rejection, or by requesting more information. Address the reasons for rejection or submit the information requested no more than 10 calendar days after the Government’s request.
5. The Government may withhold progress payments until the revised schedule is approved.

F. Final Schedule.

1. Within 30 calendar days of final acceptance of the project, submit a final schedule with actual start and finish dates for each activity.

2. Include with the submission a certification signed by a principal of the firm stating: "To the best of my knowledge, the enclosed final schedule reflects the actual start and finish dates of the activities contained herein."

G. The Government's approval of any schedule, whether initial, baseline, update, or revised, does not modify the contract or constitute endorsement or validation by the Government of the Contractor's logic, activity durations, or assumptions in creating the schedule. By approving the schedule, the Government does not guarantee that the project can be performed or completed as scheduled. If the Contractor or the Government discover errors after the schedule has been approved, correct the error(s) in the next schedule submission.

1.4 WORK ACTIVITY/EVENT COST DATA

A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost-loaded work activities/events (including alternates) shall equal the total contract price. Distribute overhead, profit, and general conditions proportionally across all work activities/events along the project's length (critical path). The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish and late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 –Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION).

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

D. The Contractor shall cost load work activities/events for all Bid Items. The sum of each Bid Item work shall equal the value of the bid item in the Contractors' bid.

E. With prior written approval from the Contracting Officer, the Contractor may request payment for suitably stored and maintained materials/equipment that conform to specifications and are ready for installation, in accordance with the provisions in VAAR 852.232 – Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). Requests must include comprehensive documentation, such as invoices, proof of payment, and evidence of secure storage with appropriate insurance. Upon approval, payment for materials will be made in accordance with contract provisions, and title to the materials shall vest in the Owner. The contractor is responsible for replacement of non-confirming or damaged materials at no additional cost to the owner. Payment for stored materials will be reflected on the schedule by cost-loading the delivery activity to represent payment upon material receipt at the site, while the installation activity will be separately cost-loaded to represent payment under completion of installation. These schedule will clearly delineate submittal, procurement, delivery (cost-loaded for stored material payment), and installation (cost-loaded for installed material payment) as distinct activities.

1.5 PROJECT SCHEDULE REQUIREMENTS

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

1. Show activities/events as:
   a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
   b. Contracting Officer's and Architect Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and

immediately preceding any VA move activity/event required by the contract phasing for that phase.

2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.
3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the VA COR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will follow review requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.

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

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

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

E. Separate Cost-Loaded Activities for Adjusting and Testing Systems:

1. The CPM shall include separate cost-loaded activities for the adjustment and testing of systems in accordance with the provisions in VAAR 852.232 –Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). The percentages provided shall be used to determine the cost of adjust and test work activities/ events, identifying the value of the work for payment purposes.

1.6 TECHNICAL REQUIREMENTS

A. Software Compatibility Requirements.

1. The Government uses Oracle Primavera P6 Professional and Microsoft Project Professional to schedule and monitor its construction projects.
2. Prepare and maintain the schedule using one of the following software options:
   a. Oracle Primavera P6 Professional (Version 22 or higher unless pre-approved)
   b. Microsoft Project Professional (Version 2021 or Higher)

B. Schedule Requirements.

1. Calculate the schedule using the Retained Logic scheduling option unless written authorization is obtained from the Government to use the Progress Override scheduling option.
2. At least 90% of all schedule activities shall be assigned to Finish-to-Start (FS) relationships.
3. Do not use the following types of logic relationships:
   a. Negative lags
   b. Lead and lag time activities
   c. Start-to-finish or finish-to-finish relationships
   Open ends. Only the first activity will have no predecessor, and only the last activity will have no successor.
   d. Constraints (a limited number of constraints may be used only with the Government’s written authorization).
   e. Manually modified dates (manually modify dates may be used only with the Government’s written authorization).
4. For any logic relationships that do not meet the criteria above in 1.6.B.2, the contractor must provide justification for the noncompliance to obtain the Government’s authorization to proceed. If the Government does not provide written authorization, the contractor must resubmit the schedule submission.

5. Include the following work activities, as applicable:
   a. Work to be performed by the contractor, subcontractors, and suppliers.
   b. Work to be performed by the Government, other contractors, and third parties such as permitting authorities or other entities required for completion of the project.
   c. The project start date, scheduled completion date, and other contractually mandated milestones, start and finish dates for phases, and site access or availability dates.
   d. Submittals and Government review and approval of submittals (– Reference specification section 01 33 23 for submission requirements).
   e. Fabrication, delivery, installation, testing, and similar activities for materials, equipment, and related items.
   f. Sampling and testing periods.
   g. Settlement or surcharge periods.
   h. Cure periods.
   i. Utility notifications, shutdowns, relocations, and similar activities.
   j. Installation, erection and removal, and similar activities related to temporary systems or structures such as temporary electrical systems or shoring.
   k. Punch list, substantial completion, final cleanup, and similar activities.
   l. Required acceptance testing, inspections, or similar activities.
   m. Durations for receipt of permits or acquisition of rights of way.
6. Define the following attributes for each activity in the schedule:
   a. A unique alphanumeric Activity ID.
   b. A unique descriptive name, using such clear, concise attributes as work type, location so each activity is easily understood. Avoid name abbreviations or overly long activity names to ensure each activity can be objectively measured and clearly understood by all stakeholders.
   c. A duration stated in workdays of no more than 20 workdays unless a longer duration is requested by the contractor and approved by the Government.
   d. Uses codes for responsibility, phasing, and staging.

1.7 SCHEDULE SUBMISSION REQUIREMENTS

A. Preparing Schedule on Owner's Database. If the schedule is prepared using My Primavera in the owner's database, then for each schedule submission, submit the following items:
   1. A transmittal letter to the owner identifying which schedule in the database is being submitted for review.
   2. A narrative report.

B. Preparing Schedule on Separate Database. If the schedule is prepared using Primavera Version 6.0, Primavera for Contractors, or another software compatible with Primavera Version 6.0, then, for each schedule submission, submit the following items:
   1. A transmittal letter
   2. A narrative report
   3. A Primavera Version 6.0 compatible electronic file of the schedule.
   4. The critical path in bar chart format (Longest Path sort)
   5. Work paths with total float values within 20 workdays of the critical path's total float value in bar chart format. For example, if the critical path has a total float value of zero, then show all the work paths with total float values of 20 or less.
   6. An activity network diagram plotted in color, on E-size paper, with each sheet of the plot including a title, match data for diagram correlation, a page number, and a legend. The activity network diagram should only be submitted with schedules with revised relationships or activity durations.
   7. An updated schedule log associated with each Monthly Schedule Update.
   8. A project S-Curve in both graphical and tabular format, displaying both schedule and cost data.
   9. A Predecessor/Successor report with the following items for each activity:
      Activity ID and description
      a.Original duration
      b.Remaining duration
      c.Calendar ID
      d.Predecessors and Successors
      e.Early start date
      f.Early finish date
      g.Late start date

h.Late finish date

i.Total float

j.Relationship type

k.Lags

l.Constraints

C. Preparing Schedule on using Microsoft Project Professional, submit the following items:

1. A transmittal letter
2. A narrative report
3. A Microsoft Project Professional .mpp electronic file of the schedule.
   a. The critical path in bar chart format (Longest Path sort)
   b. Work paths with total float values within 20 workdays of the critical path’s total float value in bar chart format. For example, if the critical path has a total float value of zero, then show all the work paths with total float values of 20 or less.
   c. An activity network diagram plotted in color, on E-size paper, with each sheet of the plot including a title, match data for diagram correlation, a page number, and a legend. The activity network diagram should only be submitted with schedules with revised relationships or activity durations.
   d. A project S-Curve in both graphical and tabular format, displaying both schedule and cost data.
   e. A Predecessor/Successor report with the following items for each activity:
      1) WBS and Task Name
      2) Baseline duration
      3) Remaining duration
      4) Predecessors and Successors
      5) Early start date
      6) Early finish date
      7) Late start date
      8) Late finish date
      9) Total slack
      10) Constraints
   f. A Lag report displaying all lags within the project schedule.

D. Narrative Reports for the Initial and Baseline Schedule. For each submission of the initial and baseline schedule provide a narrative report that includes the following information:
   1. Explanation of the overall plan to complete the project, including where the work will begin and how the work and crews will flow through the project
   2. Use and application of the workdays per week, number of shifts per day, number of hours per shift, holidays observed, and how the schedule accommodates adverse weather days for each month of activity
   3. If the project is a multi-year project, then identify the work to be completed in each construction season
   4. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date.
   5. An explanation stating why any of the contract milestone dates are forecast to occur late.
   6. A description of problems or issues anticipated
   7. A description of anticipated delays, including:
      a. Identification of the delayed activity by activity ID and description
      b. Type of delay
      c. Cause of the delay
      d. Effect of the delay on other activities, milestones, and completion dates
      e. Identification of the actions needed to avoid or mitigate the delay
      f. A description of the critical path
      g. A description of work paths with total float values within 20 workdays of the critical path’s total float value. For example, if the critical path has a total float value of zero, then describe all the work paths with total float values of 20 or less.
      h. A statement identifying constraints and an explanation of the reason for and purpose of each constraint.
      i. A statement describing the status of required permits.
      j. The statement describing the reason for the use of each lag.

E. Narrative Reports for the Monthly Schedule Update and Revised Schedule. For each submission of the monthly schedule update and revised schedule provide a narrative report that includes the following information:
   1. A description of the status of the scheduled completion date (and any contract milestone date(s)) since the last schedule submitted
   2. A statement explaining why the scheduled completion date is forecast to occur before or after the contract completion date. An explanation stating why any of the contract milestone dates are forecasted to occur late
   3. A description of the work performed since the last schedule update
   4. A description of unusual labor, shift, equipment, or material conditions or restrictions encountered or anticipated
   5. A description of the problems encountered or anticipated since the last schedule submission
   6. A statement that identifies and describes any current and anticipated delays. A discussion of delays in the narrative report does not constitute notice and does not replace the need for the contractor to provide notice as required by the contract. Include the following:
      a. Identification of the delayed activity by activity ID and description
      b. Type of delay
      c. Cause of the delay
      d. Effect of the delay on other activities, milestones, and completion dates
      e. Identification of the actions needed to avoid or mitigate the delay
      f. A description of the critical path
      g. A description of changes in the critical path and schedule completion date (for the project or its milestones) from the last schedule submission
      h. Descriptions of the status of work paths that have total float values within 20 workdays of the critical path identified in the previous schedule submission
      i. Descriptions of work paths with total float values within 20 workdays of the critical path’s total float value. For example, if the critical path has a total float value of negative 25, then

show all the near-critical paths with total float values of negative 5 or less.

j. A statement or Schedule Comparison Report that identifies the changes made between the previous schedule submission and the current proposed schedule, including, but not limited to:
   1) Data date
   2) Completion date
   3) Activity code assignments
   4) Scheduling options
   5) Activity descriptions
   6) Added activities
   7) Deleted activities
   8) Added activity relationships
   9) Deleted activity relationships
   10) Activity original durations
   11) Activity remaining durations
   12) Activity actual start and finishes
   13) Percent complete
   14) Constraints
   15) Activity resources
   16) Activity costs
   17) Activity coding

k. A statement providing the status of pending items, including, but not limited to:
   1) Permits
   2) Change orders
   3) Time extension requests
   4) Noncompliance or similar notices are indicating deficiencies in the contractor’s performance.

7. Prior to Baseline Schedule Acceptance.

a. At the time of the Pre-Construction Conference, prior to the issuance of the project Notice to Proceed, the Contractor and the Contractor’s Scheduling Consultant, will arrange a separate meeting with the Contracting Officer and/or the VA COR to discuss the requirements of this specification in detail. The Contractor and the Contractor’s scheduling consultant, will acknowledge, in writing, their understanding and compliance with the requirement of this specification.

b. With exception of bonds, insurance, and limited mobilization cost associated with preparatory work such as site trailers, staging areas, haul roads etc., the approval of the baseline NAS schedule is a condition precedent to:
   1) Processing of contractor's pay request(s) for any construction activities/items of work.
   2) Review of any schedule updates.

c. Government review comments on the contractor's schedule will not relieve the contractor from compliance with requirements of this specification section and the remaining contract documents.

1.8 QUALITY ASSURANCE

A. Quality assurance of the schedule must conform to the following standards
   1. DCMA 14-point Schedule Assessment Guidelines
   2. GAO's Schedule assessment guide - Best Practices for Project Schedules Appendix II.

1.9 PAYMENT TO THE CONTRACTOR

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a or the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.232 – Article 71 Including NAS-CPM for (PAYMENTS UNDER FIXED PRICE CONSTRUCTION). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and electronic files of the resulting monthly updated schedule, provided in both PDF and native scheduling software formats.

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

C. Payment for adjust and test activities will be made only after the Contractor has demonstrated that each of the systems is substantially complete and operates as required by the contract. The Contractor must adequately document

1.10 PAYMENT AND PROGRESS REPORTING

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

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

B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the VA COR with reports in accordance with the Article, PROJECT SCHEDULE REQUIREMENTS, specified.

C. After completing the monthly schedule update, the contractor’s representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.3 and 1.7. This electronic submission is separate from the regular monthly

project schedule update requirements and shall be submitted to the COR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

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

1.11 RESPONSIBILITY FOR COMPLETION

A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all the following remedial actions:
   1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
   2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
   3. Reschedule the work in conformance with the specification requirements.

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

1.12 ADJUSTMENT OF CONTRACT COMPLETION

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

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

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

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

- - - END - - -

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

1.2 DEFINITIONS

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

B. Shop Drawings: Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be integrated and coordinated.
1. Do not use Contract Drawings as Shop Drawings.
2.

C. Coordination Drawings: Reproducible overlay drawings showing work with horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, equipment, lights, mechanical, electrical, conveying systems, and other services:
1. In and above ceilings.
2. Within walls.
3. Within chases and shafts.
4. Under concrete floors on grade.
5. In mechanical spaces.
6. In electrical spaces.
7. Below grade.
8. In tunnel.

D. Product Data: Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures, which describe and illustrate size, physical appearance, and other characteristics of materials, systems, or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.
1. Include index if multiple items under specification section are included in submittal.
2. Mark each copy to show exact item, model, and options submitted for review.
3. Show compliance with specified reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances; notation of coordination requirements.
4. Mark through items on manufacturer's standard sheets which are not being proposed. Submittals without indications and deletions will be returned without review.

5. Include scale details, sizes, dimensions, performance characteristics, capacities, wiring diagrams, controls and other pertinent data.
6. Mark through items on manufacturer's standard sheets which are not being proposed. Submittals without indications and deletions will be returned without review.

E. Samples: Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed to establish standards by which the ensuing work can be judged.
1. Identify samples with manufacturer’s name, item, use, type, Project designation, specification section or drawing, detail reference, color, range, texture, finish and other pertinent data.
2. Samples shall have a label affixed or attached thereto of sufficient size to accommodate Contractor’s approval stamp.
3. Submit two samples of each.
4. When specific colors, textures, or patterns are not specified, submit samples from full range of manufacturer's standards for selection. When custom or standard finishes are specified, submit samples of specified colors, textures or patterns.

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

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

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

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

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

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

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

1.3 RELATED WORK

A. Section 01 33 24; ELECTRONIC SUBMITTAL PROCEDURES.

1.4 SUBMITTAL REGISTER

A. The submittal register will list items of equipment and materials for which submittals are required by the specifications. This list may not be all inclusive and additional submittals may be required by the specifications. The Contractor is not relieved from supplying submittals required by the contract documents but which have been omitted from the submittal register.

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

C. The VA will provide the initial submittal register in electronic format. Thereafter, the Contractor shall track all submittals by maintaining a complete list, including completion of all data columns,

including dates on which submittals are received and returned by the VA.

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

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

1.5 SUBMITTAL SCHEDULING

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

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

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

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

1.6 SUBMITTAL PREPARATION

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

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

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

D. All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned with review.

E. Provide a transmittal form for each submittal with the following information:
1. Project title, location and number.
2. Construction contract number.
3. Date of the drawings and revisions.
4. Name, address, and telephone number of subcontractor, supplier, manufacturer, and any other subcontractor associated with the submittal.
5. List paragraph number of the specification section and sheet number of the contract drawings by which the submittal is required.
6. Do not include or submit items not required to be submitted by Contract Documents.
7. Arrange submittals by specification section:
    a. Submittals shall include items from one specification section only.
    b. Submit Shop Drawings, Product Data, and Project Information (except for Field Test Reports) items specified in a section at same time for a complete review.
        1) Shop Drawings: Individual submittal item. Subparagraphs represent description of items to include.
            a) Indicate additional submittals that will be generated as result of dividing required submittal by building, floor, area of a floor, or other subdivision.

2) Product Data: Individual submittal item. Subparagraphs represent description of items to include as part of single submittal.
3) Sample and Information submittals: Each subparagraph represents an individual submittal item.

8. Indicate submittal number in space provided on Submittal Transmittal form. Following submittal numbering system shall be used:
   a. Identify each submittal using applicable 6 digit specification section number from Contract Documents.
   b. After section number, indicate sequence number. First submittal of section series would be numbered "## ## ##-1, next would be "## ## ##-2, etc.
   c. If returned for re-submission, add a designation character. Second submission would be "## ## ##-1A", third would be "## ## ##-1B", etc.
9. When a resubmission, add alphabetic suffix on submittal description. For example, submittal 18 would become 18A, to indicate resubmission.
10. Submit all submittals required by a section at same time which are needed for a complete review, except Contract Closeout Information Submittals, and Shop Drawing submittals divided by building area, such as; structural steel, reinforcing steel, HVAC ductwork, etc.
11. Do not submit large quantities of submittals at one time.
12. Schedule Contract Closeout Information submittals during last quarter of construction period and prior to Substantial Completion.
13. Product identification and location in project.

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

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

H. Submittals that are found to not meet contract requirements will be rejected and any perceived delay caused by incorrect/incomplete/rejected submittals is solely the contractor's responsibility and not the fault of the Government.

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

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

1.7 SUBMITTAL FORMAT AND TRANSMISSION

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

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

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

D. Provide all documents through an Electronic Submittal system. Confirm that the Electronic Submittal system can be accessed from the VA computer network. The Contractor is responsible for setting up, providing, and maintaining the Electronic Submittal system for the construction contract period of performance.

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

1.8 RFI PREPARATION AND SUBMISSION

A. Review of Contract Documents and Field Conditions:

1. Before starting each portion of Work, Contractor shall carefully study and compare various Drawings, Specifications and other Contract Documents, coordination drawings, shop drawings, prior correspondence or documentation relative to that portion of Work, as well as information furnished by COR.
2. Contractor and Subcontractors shall evaluate and take field measurements of conditions related to that portion of Work and shall observe any conditions at site affecting it.
3. These obligations are for purpose of facilitating coordination and construction by Contractor and are not for purpose of discovering errors, omissions, or inconsistencies in Contract Documents.
4. Contractor and subcontractors acknowledge that all documents pertaining to Work has been examined, have examined character of site and any existing conditions, and are satisfied with nature of Work, and other matters which can affect Work.
5. In event of inconsistency between portions of Contract Documents or within Contract Documents; provide better quality or greater quantity of Work, and comply with more stringent requirement, either or both in accordance with COR's interpretation.
6. Report errors, inconsistencies or omissions discovered in Contract Documents promptly to COR as a properly prepared and timely RFI.
7. Contractor and Subcontractors are not required to ascertain Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, and rules and regulations, unless they bear upon construction means, methods, techniques or safety and health precautions, but the Contractor shall promptly report to COR any nonconformity discovered by or made known to Contractor as a RFI.
8. On condition that Contractor or Subcontractor fail to give such notice, and knowingly proceeds with Work affected by errors or omissions in Contract Documents, Contractor shall correct any such errors, inconsistencies, or omissions at no additional cost.
9. Prior to bid, Contractor shall review existing facilities related to this contract and shall be familiar with utility requirements and construction.
    a. Existing facility documents may be available through COR for review.
    b. Perform preliminary investigations as required to ascertain extent of Work.
    c. Conditions which would be apparent by such investigation will not be allowed as cause for claims for extra costs.

B. Contractor's and Subcontractor's Responsibilities:
1. Process request through Contractor when interpretation, clarification or explanation of portion of Construction Documents is needed by Contractor, Subcontractor, Vendor or Supplier.
    a. Review request for completeness, quality, proper referencing to drawing or specification section and reason submitted.
    b. In event request is not acceptable return to submitter with comments regarding reason for being returned.
    c. Make every attempt to validate, resolve or respond to RFI by thoroughly researching and reviewing Contract Documents and field conditions.
    d. Respond to RFI accordingly if review of RFI discloses a response or is related to coordination of construction or other issue not related to Contract Documents.
    e. If request is unclear, rewrite and state in clear, concise, correct, complete and easily understood manner.
        1) Include additional information if necessary, and submit to COR for response.
2. Submit request for interpretation, clarification or explanation of Contract Documents to COR through Contractor.
    a. List specific Contract Documents researched when seeking information being requested.
    b. Reference applicable Contract Drawings by sheet number, section, detail, room number, door number, etc., Specifications by section and paragraph number, and reference other relevant documents.
    c. The field titled "Regarding" on RFI form must be clear for future reference in reports or correspondence.

d. Clearly state request and provide Contract Document references and any additional information needed so request can be fully understood, including sketches, photos or other reference material.
e. Fully assess issues, suggest any reasonable solutions and include various factors, including potential costs, schedule impacts, if any, and recommendations which will aid in determining a solution or response.
1) In event a reasonable solution can not be suggested, a statement to that effect should be so stated.
f. Indicate reason request is being submitted.
g. Clearly indicate critical RFI's requiring a rapid response with an explanation as to why RFI is critical.
h. Indicate priority for responses when multiple RFI's are submitted within short period of time.

3. Distribute copies of responses to RFI's to all parties affected.
4. Response to RFI shall not be considered a notice to proceed with a change that may revise the Contract Sum or Contract Time, unless authorized by the Contract Officer in writing.
5. In event response to RFI is determined incomplete, resubmit with explanation for unacceptability of response and necessary additional information within five (5) calendar days of receipt to RFI response.

C. RFI Submittal Process:
1. Insert entire question or requested information in "Request" portion of RFI form to include costs, schedule impact and contractors recommended solution.
2. Electronic file of sketches, photos or other pertinent information shall be included with a RFI request to clarify request.
3. Assign a unique RFI number in sequential order (1, 2, 3, 4, etc.).
4. In event previously submitted RFI request requires revision to provide additional information, initiate a new RFI.
5. New RFI shall be renumbered with previous submitted RFI proceeded by ".1 IN to indicate revision one of RFI (i.e.: RFI No. 34.1 for revision 1 to RFI No. 34).

1.9 COORDINATION DRAWINGS

A. Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities.

B. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

C. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

D. Work out all "tight" conditions involving Work of various Sections in advance of installation.

E. Sleeve, coredrill and blockout layout drawings:
1. Drawings showing proposed locations and sizes of sleeves, coredrills blockouts, and embedded items in concrete walls, columns, floors and beams.

F. Prior to start of work in any given area, each Subcontractor approve, in writing, coordination drawings affecting Subcontractor's work in that area.

G. Modifications required as result of failure to resolve interferences, provide correct coordination drawings, or call attention to changes required in other work as result of modifications shall be paid for by responsible Subcontractor.

H. Coordination meetings scheduled by Contractor, with all affected Subcontractors.

I. Production of Coordination Drawings:
1. Contractor provide minimum 1:50 1/4 IN scale plan, elevation and section drawings unless noted otherwise, showing:

a. Partitions.
b. Fire/smoke rated barriers.
c. Ceiling heights.
d. Structural framing locations and elevations.
e. Column lines.
f. Support systems.
g. Other work.
h. Existing obstructions.

2. Subcontractors produce combined coordination layout drawings plan and sections of HVAC ductwork, hydronic, steam, condensate, fuel oil, fire protection piping, plumbing, special water systems, natural gas and medical gas systems electrical cable tray, conduit, conveying systems, equipment, and other work.
3. Resolve major interferences at initial coordination meeting prior to production of any drawings.
4. Produce initial coordination drawings within 30 days after initial meeting.
5. Contractor arrange for production of said drawings not provided by that time.
6. Meet as required to resolve interferences and correct drawings.

J. After Approval:
1. After Subcontractors' written approval of coordination drawings, Contractor determine method used to resolve interferences not previously identified.
2. Contractor give written approval of changes to coordination drawings prior to start of work in affected area.
3. Maintain one copy of current approved Coordination Drawings at project site.

K. Precedence Of Services For Coordination Drawings:
1. In event of conflicts involving location and layout of work; use following priority to resolve disputes:
a. Structure and partitions have highest priority.
b. Equipment location and access.
c. Support systems
d. Ceiling system and recessed light fixtures.
e. Gravity drainage lines.
f. High pressure ductwork and devices.
g. Large pipe mains, valves and devices.
h. Pneumatic tube and material conveying systems.
i. Low pressure ductwork, diffusers, registers, grilles, HVAC equipment.
j. Fire protection piping, devices and heads.
k. Small piping, tubing, electrical conduit, and devices.
1) Conduits installed in corridors shall be maintained at least 9 IN above finished ceiling. Conduits shall be grouped within a 12 IN width.
2) The space utilized for conduit shall be selected to allow access to all devices which normally require adjustment, repair, resetting, etc.
l. Sleeves through rated partitions.
m. Access panels.

1.10 SAMPLES

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

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

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

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

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

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

1.11 OPERATION AND MAINTENANCE DATA

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

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

1.12 TEST REPORTS

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

1.13 VA REVIEW OF SUBMITTALS AND RFIS

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

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

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

D. VA review period is 21 calendar days for submittals.
1. 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, and will notify the Contractor, in writing, when COR exercises this right.

E. VA review period is 21 calendar days for RFIs.
1. COR will provide a written response to RFI if COR believes response only involves an interpretation, clarification, supplemental information not involving an adjustment in Contract Sum or extension of Contract Time, and is not inconsistent with intent of Contract Documents, and shall be binding.
2. If COR believes response may result in a change to Contract Sum or Contract Time, response will indicate that a change document will be issued for the response, and appropriate change document will be issued indicating changes to Contract Documents.
3. COR will provide any additional or supplemental drawings, specifications or other information as COR may deem necessary to facilitate response.
4. COR may return RFI without response for following reasons:
   a. Request is unclear or incomplete.
   b. Detailed information not provided.
   c. Is related to construction means, methods or techniques.
   d. Is related to health or safety measures.
   e. Is due to Contractor's lack of adequate coordination.
   f. Is for coordination between Subcontractors.
   g. Is considered a "Contractor Proposed Change".
   h. Is due to non-conformance.
   i. Response is required by another party.

F. The VA will return submittals to the Contractor with the following notations:
1. "Approved": authorizes the Contractor to proceed with the work covered.

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

1.14 APPROVED SUBMITTALS

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

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

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

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

1.15 WITHHOLDING OF PAYMENT

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

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SECTION 01 33 24

ELECTRONIC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies requirements for provision and use of an electronic, web-based service for submittal and tracking of construction submittals for the Project.

1.2 RELATED WORK

A. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.

B. Shop drawing and product data submittals shall be transmitted to COR in electronic (PDF) format using a web-based service designed specifically for transmitting and tracking submittals between construction team members.

C. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

1.4 GENERAL DESCRIPTION OF PROCEDURES

A. Submittal Preparation - Contractor may use any or all of the following options:
   1. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the electronic submittal website.
   2. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
      a. General Contractor shall perform Optical Character Resolution (OCR) routines as required by Section 01 33 23 1.6 C.
   3. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
      a. Scanning Service shall perform Optical Character Resolution (OCR) routines as required by Section 01 33 23 1.6 C.

B. Contractor shall review, comment, and apply electronic stamp certifying that the submittal (as noted) complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.

C. Contractor shall transmit each submittal to Architect and COR (simultaneously) using the web-based electronic submittal service.

D. Architect / Engineer review comments will be made available on web-based electronic submittal service. COR shall receive email notice of completed review.

E. COR review comments will be made available on web-based electronic submittal service. Contractor shall receive email notice of completed review.

F. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

1.5 REQUIREMENTS AND RESPONSIBILITIES

A. Electronic Submittal Service shall provide:

1. Web-based tracking and approval system.
2. Automated email notice for new submittals and reminders for submittals approaching the review deadline.
3. Tracking and exchange of ITC/RFI/CO's and other similar document as well as product and equipment submittals.
4. Means for tracking of the status such documents including whether they have been approved and released by the Owner.
5. Organized storage of submittals that is accessible for review by the designated construction team members at any time.
6. Submit a complete set of submittal on CD to the Owner at the end of the Project. Include all submittals included product submittals, shop drawings, ITC/RFI/CO's and other similar submittals.

B. Contractor responsibilities:
1. Training in the use of the service by the team members shall be at the option of the Contractor and, if chosen, shall be paid by the Contractor.
2. Contractor shall have or obtain required hardware and software: Internet Service and Equipment Requirements:
3. Email address and Internet access at Contractor's main office.
4. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.
5. Contractor shall prepare or have prepared all required submittals in the PDF format required.
6. PDF files must be readable. As a general rule, a resolution of 300 dpi should be used.
7. If the Architect can download more readable product data directly from the manufacturer's website than was submitted by the Contractor, the Architect shall reserve the right to reject the submittal.
8. Other responsibilities for submittals shall be as described in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
9. Color samples, color charts, or physical material samples shall be submitted as described in Section 01 33 23.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SERVICES

A. Submittal Exchange®, no substitute.

PART 3 - NOT USED

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SECTION 01 35 26
SAFETY REQUIREMENTS

1.1 APPLICABLE PUBLICATIONS:

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

B. American Society of Safety Engineers (ASSE):
- A10.1-2011 ..... Pre-Project & Pre-Task Safety and Health Planning
- A10.34-2012 ..... Protection of the Public on or Adjacent to Construction Sites
- A10.38-2013 ..... Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations

C. American Society for Testing and Materials (ASTM):
- E84-2013 ..... Surface Burning Characteristics of Building Materials

D. The Facilities Guidelines Institute (FGI):
- FGI Guidelines-2010 Guidelines for Design and Construction of Healthcare Facilities

E. National Fire Protection Association (NFPA):
- 10-2018 ..... Standard for Portable Fire Extinguishers
- 30-2018 ..... Flammable and Combustible Liquids Code
- 51B-2019 ..... Standard for Fire Prevention During Welding, Cutting and Other Hot Work
- 70-2020 ..... National Electrical Code
- 70B-2019 ..... Recommended Practice for Electrical Equipment Maintenance
- 70E-2018 ..... Standard for Electrical Safety in the Workplace
- 99-2018 ..... Health Care Facilities Code
- 241-2019 ..... Standard for Safeguarding Construction, Alteration, and Demolition Operations

F. The Joint Commission (TJC)
- TJC Manual ..... Comprehensive Accreditation and Certification Manual

G. U.S. Nuclear Regulatory Commission
- 10 CFR 20 ..... Standards for Protection Against Radiation

H. U.S. Occupational Safety and Health Administration (OSHA):
- 29 CFR 1910 ..... Safety and Health Regulations for General Industry
- 29 CFR 1926 ..... Safety and Health Regulations for Construction Industry

1.2 DEFINITIONS:

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

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

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

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

E. Accident/Incident Criticality Categories:
   1. No impact – near miss incidents that should be investigated but are not required to be reported to the VA;
   2. Minor incident/impact – incidents that require first aid or result in minor equipment damage (less than $5000). These incidents must be investigated but are not required to be reported to the VA;
   3. Moderate incident/impact – Any work-related injury or illness that results in:
      a. Days away from work (any time lost after day of injury/illness onset);
      b. Restricted work;
      c. Transfer to another job;
      d. Medical treatment beyond first aid;
      e. Loss of consciousness;
   4. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (5) above or,
   5. Any incident that leads to major equipment damage (greater than $5000).

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

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

1.3 REGULATORY REQUIREMENTS:

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

1.4 ACCIDENT PREVENTION PLAN (APP):

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

2. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
3. Address both the Prime Contractors and the subcontractors work operations.
4. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
5. Address all the elements/sub-elements and in order as follows:
   a. **SIGNATURE SHEET**. Title, signature, and phone number of the following:
      1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
      2) Plan approver (company/corporate officers authorized to obligate the company);
      3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
   b. **BACKGROUND INFORMATION**. List the following:
      1) Contractor;
      2) Contract number;
      3) Project name;
      4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
   c. **STATEMENT OF SAFETY AND HEALTH POLICY**. Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
   d. **RESPONSIBILITIES AND LINES OF AUTHORITIES**. Provide the following:
      1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;
      2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
      3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached.;
      4) Requirements that no work shall be performed unless a designated competent person is present on the job site;
      5) Requirements for pre-task Activity Hazard Analysis (AHAs);
      6) Lines of authority;
      7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
   e. **SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
      1) Identification of subcontractors and suppliers (if known);
      2) Safety responsibilities of subcontractors and suppliers.
   f. **TRAINING.**
      1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
      2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout,

confined space, etc…) and any requirements for periodic retraining/recertification are required.

3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

g. **SAFETY AND HEALTH INSPECTIONS.**
1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., “Site Safety and Health CP”), proof of inspector’s training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

h. **ACCIDENT/INCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all Moderate and Major as well as all High Visibility Incidents. The APP shall include accident/incident investigation procedure and identify person(s) responsible to provide the following to the Contracting Officer Representative or Government Designated Authority:
1) Exposure data (man-hours worked);
2) Accident investigation reports;
3) Project site injury and illness logs.

i. **PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational, patient, and public safety risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:
1) Emergency response;
2) Contingency for severe weather;
3) Fire Prevention;
4) Medical Support;
5) Posting of emergency telephone numbers;
6) Prevention of alcohol and drug abuse;
7) Site sanitation(housekeeping, drinking water, toilets);
8) Night operations and lighting;
9) Hazard communication program;
10) Welding/Cutting “Hot” work;
11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
12) General Electrical Safety;
13) Hazardous energy control (Machine LOTO);
14) Site-Specific Fall Protection & Prevention;
15) Excavation/trenching;
16) Asbestos abatement;
17) Lead abatement;
18) Crane Critical lift;
19) Respiratory protection;
20) Health hazard control program;
21) Radiation Safety Program;
22) Abrasive blasting;
23) Heat/Cold Stress Monitoring;
24) Crystalline Silica Monitoring (Assessment);
25) Demolition plan (to include engineering survey);
26) Formwork and shoring erection and removal;
27) PreCast Concrete;

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

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

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

D. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer Representative Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS):

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

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

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

1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
    a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
    b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
3. Submit AHAs to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative or Government Designated Authority.

1.6 PRECONSTRUCTION CONFERENCE:

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

B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 calendar days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.7 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP):

A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.

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

C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

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

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

1.8 TRAINING:

A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.

B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.

C. The SSHO and all designated CPs shall have completed ICRA certification within the past 3 years.

D. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented “repeat” deficiencies in the execution of safety requirements will require retaking the requisite formal course.

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

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

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

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

1.9 INSPECTIONS:

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

B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.

1. Results of the inspection will be documented with tracking of the identified hazards to abatement.
2. The Contracting Officer Representative or Government Designated Authority will be notified immediately prior to start of the inspection and invited to accompany the inspection.
3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.
4. A report of the inspection findings with status of abatement will be provided to the Contracting Officer Representative within one week of the onsite inspection.

1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS:

A. The prime contractor shall establish and maintain an accident reporting, recordkeeping, and analysis system to track and analyze all injuries and illnesses, high visibility incidents, and accidental property damage (both government and contractor) that occur on site. Notify Contracting Officer Representative or Government Designated Authority as soon as practical, but no more than four hours after any accident meeting the definition of a Moderate or Major incidents, High Visibility Incidents, , or any weight handling and hoisting equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until Contracting Officer Representative or Government Designated Authority determine whether a government investigation will be conducted.

B. Conduct an accident investigation for all Minor, Moderate and Major incidents as defined in paragraph DEFINITIONS, and property damage accidents resulting in at least $20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162 (or equivalent) , and provide the report to the Contracting Officer Representative or Government Designated Authority within 5 calendar days of the accident. The Contracting Officer Representative or Government Designated Authority will provide copies of any required or special forms.

C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative or Government Designated Authority monthly.

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

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):

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

B. Mandatory PPE includes:
1. Hard Hats – unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
2. Safety glasses - unless written authorization is given by Contracting Officer Representative or Government Designated Authority in circumstances of no eye hazards,

appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.

3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of no foot hazards.
4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

1.12 INFECTION CONTROL

A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas.

B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative or Government Designated Authority before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the Contracting Officer Representative . The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class IV**, however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:

1. Class I requirements:
   a. During Construction Work:
      1) Notify the Contracting Officer Representative or Government Designated Authority
      2) Execute work by methods to minimize raising dust from construction operations.
      3) Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.
   b. Upon Completion:
      1) Clean work area upon completion of task
      2) Notify the Contracting Officer Representative or Government Designated Authority
2. Class II requirements:
   a. During Construction Work:
      1) Notify the Contracting Officer Representative or Government Designated Authority
      2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
      3) Water mist work surfaces to control dust while cutting.
      4) Seal unused doors with duct tape.
      5) Block off and seal air vents.
      6) Remove or isolate HVAC system in areas where work is being performed.
   b. Upon Completion:
      1) Wipe work surfaces with cleaner/disinfectant.
      2) Contain construction waste before transport in tightly covered containers.

3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
4) Upon completion, restore HVAC system where work was performed
5) Notify the Contracting Officer Representative or Government Designated Authority

3. Class III requirements:
   a. During Construction Work:
      1) Obtain permit from the Contracting Officer Representative or Government Designated Authority
      2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
      3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
      4) Maintain negative air pressure, 0.03 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
      5) Contain construction waste before transport in tightly covered containers.
      6) Cover transport receptacles or carts. Tape covering unless solid lid.
   b. Upon Completion:
      1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative or Government Designated Authority and thoroughly cleaned by the VA Environmental Services Department.
      2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
      3) Vacuum work area with HEPA filtered vacuums.
      4) Wet mop area with cleaner/disinfectant.
      5) Upon completion, restore HVAC system where work was performed.
      6) Return permit to the Contracting Officer Representative or Government Designated Authority
4. Class IV requirements:
   a. During Construction Work:
      1) Obtain permit from the Contracting Officer Representative or Government Designated Authority
      2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.
      3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
      4) Maintain negative air pressure, 0.03 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
      5) Seal holes, pipes, conduits, and punctures.
      6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work

site or they can wear cloth or paper coveralls that are removed each time they leave work site.

7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative or Government Designated Authority with thorough cleaning by the VA Environmental Services Dept.
2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
3) Contain construction waste before transport in tightly covered containers.
4) Cover transport receptacles or carts. Tape covering unless solid lid.
5) Vacuum work area with HEPA filtered vacuums.
6) Wet mop area with cleaner/disinfectant.
7) Upon completion, restore HVAC system where work was performed.
8) Return permit to the Contracting Officer Representative or Government Designated Authority

C. Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
   a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the Resident Engineer and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping
   b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
   c. Class III & IV - Seal all penetrations in existing barrier airtight
   d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris
   e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
   f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.

D. Products and Materials:

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

E. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.

F. A dust control program will be established and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

G. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.

H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
   1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
   2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
   3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
   4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.
   5. The contractor shall not haul debris through patient-care areas without prior approval of the Resident Engineer and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
   6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
   7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

I. Final Cleanup:
   1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
   2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
   3. All new air ducts shall be cleaned prior to final inspection.

J. Exterior Construction
   1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.
   2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary

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

1.13 TUBERCULOSIS SCREENING

A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site. NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.
   1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.
   2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.
   3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

1.14 FIRE SAFETY

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

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

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

D. Temporary Construction Partitions:
   1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
   2. Install one-hour fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
   3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

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

F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative or Government Designated Authority.

G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative or Government Designated Authority.

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

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

J. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.

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

L. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative or Government Designated Authority.

M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative. Obtain permits from Contracting Officer Representative at least 48hours in advance . Designate contractor's responsible project-site fire prevention program manager to permit hot work.

N. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative or Government Designated Authority.

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

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

Q. If required, submit documentation to the COR or other Government Designated Authority that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.15 ELECTRICAL

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

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

C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work

Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative or Government Designated Authority with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA and permit specific to energized work activities will be developed, reviewed, and accepted by the VA prior to the start of that activity.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the The Contracting Officer Representative or Government Designated Authority.

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

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

1.16 FALL PROTECTION

A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.

1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
4. Fall protection while using a ladder will be governed by the OSHA requirements.

1.17 SCAFFOLDS AND OTHER WORK PLATFORMS

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

B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.

C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.
   1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
   2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
   3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
   4. Emergency descent devices shall not be used as working platforms.

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

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

1.18 EXCAVATION AND TRENCHES

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

B. All excavations and trenches 24 inches in depth or greater shall require a written trenching and excavation permit (NOTE – some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall have two sections, one section will be completed prior to digging or drilling and the other will be completed prior to personnel entering the excavations greater than 5 feet in depth. Each section of the permit shall be provided to the Contracting Officer Representative and/or other Government Designated Authority prior to proceeding with digging or drilling and prior to proceeding with entering the excavation. After completion of the work and prior to opening a new section of an excavation, the permit shall be closed out and provided to the Contracting Officer Representative and/or other Government Designated Authority. The permit shall be maintained onsite and the first section of the permit shall include the following:
   1. Estimated start time & stop time
   2. Specific location and nature of the work.
   3. Indication of the contractor's "Competent Person" (CP) in excavation safety with qualifications and signature. Formal course in excavation safety is required by the contractor's CP.
   4. Indication of whether soil or concrete removal to an offsite location is necessary.
   5. Indication of whether soil samples are required to determined soil contamination.
   6. Indication of coordination with local authority (i.e. "One Call") or contractor's effort to determine utility location with search and survey equipment.
   7. Indication of review of site drawings for proximity of utilities to digging/drilling.

C. The second section of the permit for excavations greater than five feet in depth shall include the following:
   1. Determination of OSHA classification of soil. Soil samples will be from freshly dug soil with samples taken from different soil type layers as necessary and placed at a safe

distance from the excavation by the excavating equipment. A pocket penetronmeter will be utilized in determination of the unconfined compression strength of the soil for comparison against OSHA table (Less than 0.5 Tons/FT2 – Type C, 0.5 Tons/FT2 to 1.5 Tons/FT2 – Type B, greater than 1.5 Tons/FT2 – Type A without condition to reduce to Type B).

2. Indication of selected protective system (sloping/benching, shoring, shielding). When soil classification is identified as “Type A” or “Solid Rock”, only shoring or shielding or Professional Engineer designed systems can be used for protection. A Sloping/Benching system may only be used when classifying the soil as Type B or Type C. Refer to Appendix B of 29 CFR 1926, Subpart P for further information on protective systems designs.
3. Indication of the spoil pile being stored at least 2 feet from the edge of the excavation and safe access being provided within 25 feet of the workers.
4. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist. Internal combustion engine equipment is not allowed in an excavation without providing force air ventilation to lower the concentration to below OSHA PELs, providing sufficient oxygen levels, and atmospheric testing as necessary to ensure safe levels are maintained.

D. As required by OSHA 29 CFR 1926.651(b)(1), the estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.
1. The planned dig site will be outlined/marked in white prior to locating the utilities.
2. Used of the American Public Works Association Uniform Color Code is required for the marking of the proposed excavation and located utilities.
3. 811 will be called two business days before digging on all local or State lands and public Right-of Ways.
4. Digging will not commence until all known utilities are marked.
5. Utility markings will be maintained

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

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

1.19 CRANES

A. All crane work shall comply with 29 CFR 1926 Subpart CC.

B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no “Phase In” date.

C. A detailed lift plan for all lifts shall be submitted to the Contracting Officer Representative and/or other Government Designated Authority 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing and all other elements of a critical lift plan where the lift meets the definition of a critical lift. Critical lifts require a more comprehensive lift plan to minimize the potential of crane failure and/or catastrophic loss. The plan must be reviewed and accepted by the General Contractor before being submitted to the VA for review. The lift will not be allowed to proceed without prior acceptance of this document.

D. Crane operators shall not carry loads
1. over the general public or VAMC personnel
2. over any occupied building unless

a. the top two floors are vacated
b. or overhead protection with a design live load of 300 psf is provided

1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

A. Contractor's Lockout/Tagout (LOTO) program shall be submitted for review and approval as part of the APP. All LOTO documents necessary for work shall be submitted to the VA COR. Each LOTO action will require a scope specific LOTO documentation.

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

1.21 CONFINED SPACE ENTRY

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

B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Contracting Officer Representative and/or other Government Designated Authority.

1.22 WELDING AND CUTTING

A. As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative and/or other Government Designated Authority. Obtain permits from Contracting Officer Representative and/or other Government Designated Authority at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.23 LADDERS

A. All Ladder use shall comply with 29 CFR 1926 Subpart X.

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

C. Manufacturer safety labels shall be in place on ladders

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

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

F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

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

1.24 FLOOR & WALL OPENINGS

A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.

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

C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
   1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.
   2. Covers shall be secured when installed, clearly marked with the word “HOLE”, “COVER” or “Danger, Roof Opening-Do Not Remove” or color-coded or equivalent methods (e.g., red or orange “X”). Workers must be made aware of the meaning for color coding and equivalent methods.
   3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
   4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
   5. Workers are prohibited from standing/walking on skylights.

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SECTION 01 42 19

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

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

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

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

1. AA Aluminum Association Inc.
   http://www.aluminum.org
2. AABC Associated Air Balance Council
   https://www.aabc.com
3. AAMA American Architectural Manufacturer's Association
   http://www.aamanet.org
4. AASHTO American Association of State Highway and Transportation Officials
   http://www.aashto.org
5. AATCC American Association of Textile Chemists and Colorists
   http://www.aatcc.org
6. ACGIH American Conference of Governmental Industrial Hygienists
   http://www.acgih.org

7. ACI American Concrete Institute
   http://www.aci-int.net
8. ACPA American Concrete Pipe Association
   http://www.concrete-pipe.org
9. ACPPA American Concrete Pressure Pipe Association
   http://www.acppa.org
10. ADC Air Diffusion Council
    http://flexibleduct.org
11. AGA American Gas Association
    http://www.aga.org
12. AGC Associated General Contractors of America
    http://www.agc.org
13. AGMA American Gear Manufacturers Association, Inc.
    http://www.agma.org
14. AH American Hort
15. https://www.americanhort.org
16. AHAM Association of Home Appliance Manufacturers
    http://www.aham.org
17. AIA American Institute of Architects
18. http://www.aia.org
19. AISC American Institute of Steel Construction
    http://www.aisc.org
20. AISI American Iron and Steel Institute
    http://www.steel.org
21. AITC American Institute of Timber Construction
    https://aitc-glulam.org
22. AMCA Air Movement and Control Association, Inc.
    http://www.amca.org
23. ANSI American National Standards Institute, Inc.
    http://www.ansi.org
24. APA The Engineered Wood Association
    http://www.apawood.org
25. ARI Air-Conditioning and Refrigeration Institute
    http://www.ari.org
26. ARPM Association for Rubber Product Manufacturers
27. https://arpm.com
28. ASABE American Society of Agricultural and Biological Engineers
    https://www.asabe.org
29. ASCE American Society of Civil Engineers
    http://www.asce.org
30. ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
    http://www.ashrae.org
31. ASME American Society of Mechanical Engineers
    http://www.asme.org
32. ASSE American Society of Sanitary Engineering International
    http://www.asse-plumbing.org
33. ASTM American Society for Testing and Materials International
    http://www.astm.org
34. AWI Architectural Woodwork Institute
    https://www.awinet.org
35. AWS American Welding Society
    https://www.aws.org
36. AWWA American Water Works Association
    https://www.awwa.org

37. BHMA Builders Hardware Manufacturers Association
https://www.buildershardware.com
38. BIA The Brick Industry Association
http://www.gobrick.com
39. CAGI Compressed Air and Gas Institute
https://www.cagi.org
40. CGA Compressed Gas Association, Inc.
https://www.cganet.com
41. CI The Chlorine Institute, Inc.
https://www.chlorineinstitute.org
42. CISCA Ceilings and Interior Systems Construction Association
https://www.cisca.org
43. CISPI Cast Iron Soil Pipe Institute
https://www.cispi.org
44. CLFMI Chain Link Fence Manufacturers Institute
https://www.chainlinkinfo.org
45. CPA Composite Panel Association
46. https://www.compositepanel.org
47. CPMB Concrete Plant Manufacturers Bureau
https://www.cpmb.org
48. CRA California Redwood Association
http://www.calredwood.org
49. CRSI Concrete Reinforcing Steel Institute
https://www.crsi.org
50. CTI Cooling Technology Institute
https://www.cti.org
51. DHA Decorative Hardwoods Association
52. https://www.decorativehardwoods.org
53. DHI Door and Hardware Institute
https://www.dhi.org
54. EGSA Electrical Generating Systems Association
http://www.egsa.org
55. EEI Edison Electric Institute
https://www.eei.org
56. EPA United States Environmental Protection Agency
https://www.epa.gov
57. ETL ETL Testing Services
http://www.intertek.com
58. FAA Federal Aviation Administration
https://www.faa.gov
59. FCC Federal Communications Commission
https://www.fcc.gov
60. FGI Facility Guidelines Institute
    a. https://fgiguidelines.org
61. FPS Forest Products Society
http://www.forestprod.org
62. GANA Glass Association of North America
http://www.glasswebsite.com
63. FM Factory Mutual Global Insurance
https://www.fmglobal.com
64. GA Gypsum Association
https://gypsum.org
65. GSA General Services Administration
https://www.gsa.gov
66. HI Hydraulic Institute
http://www.pumps.org

67. ICC International Code Council
https://shop.iccsafe.org
68. ICEA Insulated Cable Engineers Association
https://www.icea.net
69. ICAC Institute of Clean Air Companies
http://www.icac.com
70. IEEE Institute of Electrical and Electronics Engineers
https://www.ieee.org
71. IGMA Insulating Glass Manufacturers Alliance
72. https://www.igmaonline.org
73. IMSA International Municipal Signal Association
http://www.imsasafety.org
74. MBMA Metal Building Manufacturers Association
https://www.mbma.com
75. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
http://msshq.org
76. NAAMM National Association of Architectural Metal Manufacturers
https://www.naamm.org
77. PHCC Plumbing-Heating-Cooling Contractors Association
https://www.phccweb.org
78. NBS National Bureau of Standards
See - NIST
79. NBBI The National Board of Boiler and Pressure Vessel Inspectors
https://www.nationalboard.org
80. NEC National Electric Code
See - NFPA National Fire Protection Association
81. NEMA National Electrical Manufacturers Association
https://www.nema.org
82. NFPA National Fire Protection Association
https://www.nfpa.org
83. NHLA National Hardwood Lumber Association
https://www.nhla.com
84. NIH National Institute of Health
https://www.nih.gov
85. NIST National Institute of Standards and Technology
https://www.nist.gov
86. NELMA Northeastern Lumber Manufacturers Association, Inc.
http://www.nelma.org
87. NPA National Particleboard Association
(See CPA, Composite Panel Association)
88. NSF National Sanitation Foundation
http://www.nsf.org
89. OSHA Occupational Safety and Health Administration
Department of Labor
https://www.osha.gov
90. PCA Portland Cement Association
https://www.cement.org
91. PCI Precast Prestressed Concrete Institute
https://www.pci.org
92. PPI Plastics Pipe Institute
https://www.plasticpipe.org
93. PEI Porcelain Enamel Institute
http://www.porcelainenamel.com
94. PTI Post-Tensioning Institute
http://www.post-tensioning.org

95. RFCI Resilient Floor Covering Institute
https://www.rfci.com
96. RIS Redwood Inspection Service
(See Western Wood Products Association)
97. https://www.wwpa.org
98. SCMA Southern Cypress Manufacturers Association
http://www.cypressinfo.org
99. SDI Steel Door Institute
http://www.steeldoor.org
100. SJI Steel Joist Institute
https://www.steeljoist.org
101. SMACNA Sheet Metal & Air-Conditioning Contractors' National Association
https://www.smacna.org
102. SSPC The Society for Protective Coatings
https://www.sspc.org
103. STI Steel Tank Institute
https://www.steeltank.com
104. SWI Steel Window Institute
https://www.steelwindows.com
105. TCNA Tile Council of North America
106. https://www.tcnatile.com
107. TEMA Tubular Exchanger Manufacturers Association
http://www.tema.org
108. TPI Truss Plate Institute
https://www.tpinst.org
109. UBC The Uniform Building Code
(See ICC)
110. UL Underwriters' Laboratories Incorporated
https://www.ul.com
111. ULC Underwriters' Laboratories of Canada
https://www.ulc.ca
112. WCLB West Coast Lumber Inspection Bureau
http://www.wclib.org
113. WDMA Window and Door Manufacturers Association
114. https://www.wdma.com
115. WRCLA Western Red Cedar Lumber Association
https://www.realcedar.com
116. WWPA Western Wood Products Association
http://www.wwpa.org

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SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 APPLICABLE PUBLICATIONS

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

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

1.3 SUBMITTALS

A. Government approval is required for all submittals. CQC inspection reports shall be submitted under this Specification section and follow the Applicable Specification section naming convention.
   1. Preconstruction Submittals
      a. Interim CQC Plan
      b. CQC Plan
   2. Test Reports
      a. Verification Statement
   3. Third-Party Inspection Reports
      a. Comprehensive 3rd party inspections, testing and written reports for all Divisions (paid by the General Contractor). Contractor shall employ third party inspection consultants to perform all inspections required by this contract. The VA has no inspection capability. Any reference to VA inspections shall be by a third-party inspector qualified to perform the work. Credentials shall be supplied to the VA/AE as required by this contract. All inspections, testing, certifications, and permits are to be paid for by the General Contractor. The VA will not pay for or perform any required third-party inspections. VA inspections are for VA use only, when performed, and do not reduce the inspection burden on the Contractor. Third party inspection services must be submitted for acceptance by the VA after award. Submission to include resumes of inspectors, with alternates, projected days on site, qualifications of inspectors showing similar projects, related portfolio, and description of communication protocol with Owner. Minimum qualifications for each Division's inspector are identified in 01 45 00 "Experience Matrix". Third-Party inspections are in addition to, and independent of, the General Contractor's primary Quality Control Manager and associated protocol or Government/AE Construction Period Services.
      b. Third-Party Inspection Report shall be submitted to the COR.
      c. Inspection reports shall include work inspected or tested was or was not completed in conformance to approved construction documents.
         1) Discrepancies shall be brought to the immediate attention of the contractor and COR.
      d. Final Third-Party Inspection Report:

1) Prior to the start of Commissioning activities, the Third-Party Inspection contractor shall submit a final Report documenting inspections and tests, and correction of any discrepancies noted in the inspections or tests.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

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

3.2 CQC PLAN:

A. Submit the CQC Plan no later than 30 days after receipt of Notice to Proceed (NTP) proposed to implement the requirements of the FAR Clause 52.246.12 titled “Inspection of Construction”. The Government will consider an Interim CQC Plan for the first 30 days of operation, which must be accepted within 10 business days of NTP. Design and/or construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an Interim plan applicable to the particular feature of work to be started. Work outside of the accepted Interim CQC Plan will not be permitted to begin until acceptance of a CQC Plan or another Interim CQC Plan containing the additional work scope is accepted.

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

1. A description of the QC organization, including a chart showing lines of authority and acknowledgement that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.
2. The name, qualifications (in resume format) duties, responsibilities, and authorities of each person assigned a CQC function.
3. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer or Authorized designee.
4. Procedures for scheduling, reviewing, certifying, and managing submittals including those of subcontractors, designers of record, consultants, A/E’s offsite fabricators, suppliers and purchasing agents. These procedures must be in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
5. Control, verification, and acceptance of testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested,

test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer or Authorized designee are required to be used)

6. Procedures for tracking Preparatory, Initial, and Follow-Up control phases and control, verification, and acceptance tests including documentation.
7. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.
8. Reporting procedures, including proposed reporting formats.
9. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of specifications can generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the Coordination meeting.
10. Coordinate schedule work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections and Schedule of Special Inspections. Where the applicable Code issue by the International Code Council (ICC) calls for inspections by the Building Official, the Contractor must include the inspections in the CQC Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors. Include the Special Inspection Plan requirements in the CQC Plan.

C. Acceptance of Plan: Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during construction. The Government reserves the right to require the Contractor to make changes in the CQC Plan and operations including removal of personnel as necessary, to obtain the quality specified.

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

3.3 COORDINATION MEETING:

A. After the Preconstruction Conference Post-award Conference before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized designee to discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 5 business days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and Contracting Officer or Authorized designee and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION:

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

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

B. CQC System Manager: Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC system Manager is required to be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to the scope of this Contract. This CQC System manager is on the site at all times during construction and is employed by the General Contractor. Identify in the plan an alternate to serve in the event of the CDQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager. The CQC System Manager shall be a separate individual from the contractor's superintendent,

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

D. Third-Party Inspection Personnel:
   1. In addition to CQC personnel specified elsewhere in the contract, provide Third-Party Inspection Personnel as part of the CQC organization specialized personnel to assist in the CQC System Manager for the following areas, as applicable: electrical, mechanical, civil, structural, environmental, architectural, and low voltage systems.
   2. These individuals or specified technical companies are subcontracted by the General Contractor; be responsible to the CQC System Manager & COR; be physically present at the construction site to observe, inspect, test, and report the results before work is covered up. These individuals or specified technical companies shall have provide the specialized personnel's areas of responsibility; have the necessary education or experience in accordance with the Experience Matrix listed herein.
   3. These individuals or companies have no other duties other than Third-Party Inspection. A single person can cover more than one area provided that the single person is qualified to perform Third-Party Inspection activities in each designated and that workload allows.
   4. The individuals or specified technical companies shall be subject to acceptance by the Contracting Officer or Authorized designee.
   5. These individuals or specified technical companies are not the same as Special Inspector of Record per Section 01 45 35, SPECIAL INSPECTIONS.

E. EXPERIENCE MATRIX

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

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

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

3.5 SUBMITTALS AND DELIVERABLES:

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

1. Third-Party Inspection individuals or specified technical companies shall review the submittals before the contractor submits to the COR.

3.6 CONTROL:

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

1. Preparatory Phase: This phase is performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:
   a. A review of each paragraph of applicable specifications, references codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.
   b. Review of the Contract drawings.
   c. Check to assure that all materials and equipment have been tested, submitted, and approved.
   d. Review of provisions that have been made to provide required control inspection and testing.
   e. Review Special Inspections required by Section 01 45 35 Special Inspections, that Statement of Special Inspections and the Schedule of Specials Inspections.
   f. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.
   g. Examination of required materials, equipment, and sample work to assure that they are on hand conform to approved shop drawings or submitted data, and are properly stored.
   h. Review of the appropriate Activity Hazard Analysis (AHA) to assure safety requirements are met.
   i. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards – contract defined or industry standard if not contract defined - for that feature of work.
   j. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
   k. Discussion of the initial control phase.
   l. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the Preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the Preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

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

1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the Preparatory meeting.
2. Verify adequacy of controls to ensure full contract compliance. Verify the required control inspection and testing is in compliance with the contract.
3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
4. Resolve all differences.
5. Check safety to include compliance with an upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
6. The Government needs to be notified at least 48 hours or 2 business days in advance of beginning the initial phase for definable features of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with Follow-Up phases.
7. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
8. Coordinate scheduled work with Special Inspections required by Section 01 45 35 Special Inspections, the Statement of Special Inspections, and the Schedule of Special Inspections.

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

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

3.7 TESTS

A. Testing Procedure: Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and acceptance test when specified. Procure the services of a Department of Veteran Affairs approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:
1. Verify that testing procedures comply with contract requirements.
2. Verify that facilities and testing equipment are available and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
5. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the unique sequential control number identifying the test. If approved by the Contracting Officer or Authorized designee, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer or Authorized designee. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

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

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

3.8 COMPLETION INSPECTION

A. Punch-Out Inspection: Conduct an inspection of the work by the CQC system Manager near the end of the work, or any increment of the work established by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final Inspection.

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

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

3.9 DOCUMENTATION

A. Quality Control Activities: Maintain current records providing factual evidence that required QC activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:
   1. The name and area of responsibility of the Contractor/Subcontractor
   2. Operating plant/equipment with hours worked, idle, or down for repair.
   3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

4. Test and control activities performed with results and references to specification/drawing requirements. Identify the Control Phase (Preparatory, Initial, and/or Follow-Up). List deficiencies noted, along with corrective action.
5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specification/drawing requirements.
6. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. Instructions given/received and conflicts in plans and specifications.

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

3.10 SAMPLE FORMS

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

3.11 NOTIFICATION OF NONCOMPLIANCE:

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

--- END OF SECTION ---

CONTRACTOR'S QUALITY CONTROL REPORT (QCR) (ER 1180-1-6)	DATE:	REPORT NO.:

CONTRACT NUMBER AND NAME OF CONTRACTOR:	DESCRIPTION AND LOCATION OF THE WORK:

WEATHER CLASSIFICATION:

CLASS A No interruptions of any kind from weather conditions occurring on this or previous shifts.

CLASS B Weather occurred during this shift that caused a complete stoppage of all work.

CLASS C Weather occurred during this shift that caused a partial stoppage of work.

CLASS D Weather overhead excellent or suitable during shift. Work completely stopped due to results of previous adverse weather.

CLASS E Weather overhead excellent or suitable during shift but work partially stopped due to previous adverse manner.

OTHER Explain.

CLASSIFICATION:

CLASS _____

TEMPERATURE:

MAX _____ MIN _____

PRECIPITATION:

INCHES _____

CONTRACTOR/SUBCONTRACTORS AND AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY: *(Attach list of items of equipment either idle or working as appropriate.)*

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

1. WORK PERFORMED TODAY: (Indicate location and description of work performed. Refer to work performed by prime and/or subcontractors by letter in Table above.)

PURPOSE: Contractors Daily QC Report. Revision necessitated by EIG recommendation
MONTHLY USAGE: 1,500
PRESCRIBING DIRECTIVE: ER 1180-1-6
FUNCTIONAL CODE: 1180 Series - Engineer Contracts

2. TYPE AND RESULTS OF INSPECTION: (Indicate whether: P - Preparatory, I - Initial, or F - Follow-up and include satisfactory work completed or deficiencies with action to be taken.)

3. TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS OF TESTS:

4. VERBAL INSTRUCTIONS RECEIVED: (List any instructions given by Government personnel on construction deficiencies. retesting required, etc., with action to be taken.)

5. REMARKS: (Cover any conflicts in plans, specifications or instructions: acceptability of incoming materials: offsite surveillance activities; progress of work, delays, causes and extent thereof; days of no work with reasons for same.)

6. SAFETY: (Include any infractions of approved safety plan, safety manual or instructions from Government personnel. Specify corrective action taken.)

INSPECTOR

CONTRACTOR'S CERTIFICATION: I certify that the above report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period were in strict compliance with the contract plans and specifications except as noted above.

CONTRACTOR'S APPROVED AUTHORIZED REPRESENTATIVE

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the General Contractor .

B. Before placement and installation of work subject to tests by testing laboratory retained by General Contractor, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three workdays unless otherwise designated by the COR.

C. All testing shall be by certified testing laboratories subcontracted by the Contract. The Government shall not be required to contract testing for any trade.

1.2 APPLICABLE PUBLICATIONS:

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

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-11	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
T96-02 (R2006)	Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-10	Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
T104-99 (R2007)	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T180-10	Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
T191-02(R2006)	Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
T310-13	Standard Method of Test for In-place Density and Moisture Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)

C. American Concrete Institute (ACI):

506.4R-94 (R2004)	Guide for the Evaluation of Shotcrete

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

A370-12	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A416/A416M-10	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
C31/C31M-10	Standard Practice for Making and Curing Concrete Test Specimens in the Field
C33/C33M-11a	Standard Specification for Concrete Aggregates

C39/C39M-12	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-11b	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
C136-06	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
C138/C138M-10b	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
C140-12	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-10a	Standard Test Method for Slump of Hydraulic Cement Concrete
C172/C172M-10	Standard Practice for Sampling Freshly Mixed Concrete
C173/C173M-10b	Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09	Standard Specification for Lightweight Aggregates for Structural Concrete
C567/C567M-11	Standard Test Method for Density Structural Lightweight Concrete
C780-11	Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11	Standard Test Method for Sampling and Testing Grout
C1064/C1064M-11	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
C1077-11c	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
C1314-11a	Standard Test Method for Compressive Strength of Masonry Prisms
D422-63(2007)	Standard Test Method for Particle-Size Analysis of Soils
D698-07e1	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
D1140-00(2006)	Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve
D1143/D1143M-07e1	Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
D1188-07e1	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
D1556-07	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-09	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft lbf/ft^3 (2,700 KNm/m^3))
D2166-06	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

D2167-08) ..... Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2216-10..... Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2974-07a..... Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3666-11..... Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D3740-11..... Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction

D6938-10..... Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

E94-04(2010) ..... Standard Guide for Radiographic Examination

E164-08..... Standard Practice for Contact Ultrasonic Testing of Weldments

E329-11c..... Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

E543-09..... Standard Specification for Agencies Performing Non-Destructive Testing

E605-93(R2011)..... Standard Test Methods for Thickness and Density of Sprayed Fire Resistive Material (SFRM) Applied to Structural Members

E709-08..... Standard Guide for Magnetic Particle Examination

E1155-96(R2008)..... Determining FF Floor Flatness and FL Floor Levelness Numbers

F3125/F3125M-15..... Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

E. American Welding Society (AWS):
D1.D1.1M-10 ..... Structural Welding Code-Steel

1.3 REQUIREMENTS:

A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.

C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 and/or ASTM D1557 as indicated in the geotechnical report.
2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 , or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
    a. Building Slab Subgrade: At least one test of subgrade for every 185 m^2 (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m^2 (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
    b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
    c. Pavement Subgrade: One test for each 335 m^2 (400 square yards), but in no case fewer than two tests.
    d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
    e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
    f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to COR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.

C. Fill and Backfill Material Gradation: One test per cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C136 ASTM D422 ASTM D1140.

D. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

E. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

3.2 LANDSCAPING:

A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
1. Test for organic material by using ASTM D2974.
2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.

B. Submit laboratory test report of topsoil to COR.

3.3 SITE WORK CONCRETE:

A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.4 CONCRETE:

A. Batch Plant Inspection and Materials Testing:
1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by COR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:
1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. [Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For

concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.

6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
    b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. 18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:
    a. Grouting under base plates.
    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows:

Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.

2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COR. In test report, indicate the following information:
   a. Cylinder identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Type of concrete, slump, and percent air.
   d. Compressive strength of concrete in MPa (psi).
   e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
   f. Weather conditions during placing.
   g. Temperature of concrete in each test cylinder when test cylinder was molded.
   h. Maximum and minimum ambient temperature during placing.
   i. Ambient temperature when concrete sample in test cylinder was taken.
   j. Date delivered to laboratory and date tested.

3.5 REINFORCEMENT:

A. Review mill test reports furnished by Contractor.

B. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).

C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.6 MASONRY:

A. Mortar Tests:
   1. Laboratory compressive strength test:
      a. Comply with ASTM C780.
      b. Obtain samples during or immediately after discharge from batch mixer.
      c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
      d. Test one sample at 7 days and 2 samples at 28 days.
   2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:
   1. Laboratory compressive strength test:
      a. Comply with ASTM C1019.
      b. Test one sample at 7 days and 2 samples at 28 days.
      c. Perform test for each 230 m^2 (2500 square feet) of masonry.

C. Masonry Unit Tests:
   1. Laboratory Compressive Strength Test:
      a. Comply with ASTM C140.
      b. Test 3 samples for each 460 m^2 (5000 square feet) of wall area.

D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m^2 (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.7 STRUCTURAL STEEL:

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:
   1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
   2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
   3. Approve welder qualifications by certification or retesting.
   4. Approve procedure for control of distortion and shrinkage stresses.
   5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:
   1. Weld Inspection:
      a. Inspect welding equipment for capacity, maintenance and working condition.
      b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
      c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
      d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
      e. Measure 25 percent of fillet welds.
      f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
         1) 20 percent of all shear plate fillet welds at random, final pass only.
         2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
         3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
         4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
         5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
      g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
      h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
      i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
      j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
   2. Bolt Inspection:
      a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM F3125 Bolts.
      b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM F3125 Bolts. Inspect all bolts in connection when one or more are rejected.
      c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM F3125 Bolts. Inspect all bolts in connection when one or more are rejected.

d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
f. f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COR.

3.8 STEEL DECKING:

A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."

C. Submit inspection reports, certification, and instances of noncompliance to COR.

3.9 SHEAR CONNECTOR STUDS:

A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.

B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.

C. Submit inspection reports, certification, and instances of noncompliance to COR.

3.10 SPRAYED-ON FIREPROOFING:

A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.

B. Obtain a copy of approved submittals from COR.

C. Use approved installation in test areas as criteria for inspection of work.

D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.

E. Location of test areas for field tests as follows:
1. Thickness: Select one bay per floor, or one bay for each 930 m^2 (10,000 square feet) of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.
2. Density: Take density determinations from each floor, or one test from each 930 m^2 (10,000 square feet) of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.

F. Submit inspection reports, certification, and instances of noncompliance to COR.

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SECTION 01 45 35

SPECIAL INSPECTIONS

PART 1 - PART 1 – GENERAL

1.1 DESCRIPTION

A. This guide specification will be applicable to both new buildings and existing building rehabilitations/renovations. In addition to the Special Inspection and testing specified requirements, a registered design professional must perform structural observations during construction. All observed deficiencies will be immediately reported to the Contracting Officer. The registered design professional performing these observations will be a representative of the Designer of Record (DOR) for the building being constructed.

B. Structural observations are required for the following project conditions per IBC Chapter 17:
   1. Seismic Design Category D, E or F; and assigned to Risk Cat III, IV or V.
   2. Seismic Design Category D, E or F; and with a height greater than 22860 mm 75 ft.
   3. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two stories above grade plane.
   4. Nominal design wind speed in excess of 49 m/sec 110 mph; and assigned to Risk Cat III, IV or V.
   5. Nominal design wind speed in excess of 49 m/sec 110 mph; and with a height greater than 23 m 75 ft.

1.2 APPLICABLE PUBLICATIONS

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

B. American Society of Civil Engineers (ASCE)
   1. ASCE 7 - (2010; Errata 2011; Supp 2 2013) Minimum Design Loads for Buildings and Other Structures

C. International Code Council (ICC)
   1. ICC IBC - (2021) International Building Code

1.3 GENERAL REQUIREMENTS

A. Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the prime contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

1.4 DEFINITIONS

A. Continuous Special Inspections – The constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

B. Periodic Special Inspections – Special Inspections by the special inspector who is intermittently present where the work to be inspected has been or is being performed. Specific time interval on a specific Special Inspection should be indicated on the Schedule of Special Inspections.

C. Perform – Perform these Special Inspections tasks for each welded joint or member.

D. Observe – Observe these Special Inspections items on a random daily basis. Operations need not be delayed pending these inspections.

E. Special Inspector (SI) – A qualified person retained by the contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

F. Associate Special Inspector (ASI) – A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

G. Third Party – A third party inspector must not be company employee of the Contractor or any Sub-Contractor performing the work to be inspected.

H. Special Inspector of Record (SIOR) – SIOR must be an independent third party hired directly by the Prime Contractor and is required for the following project conditions:
   1. Seismic Design Category D, E, or F; and assigned to Risk Category III, IV, or V.
   2. Seismic Design Category D, E, or F; and with a height greater than 22860mm 75 ft.
   3. Seismic Design Category E, assigned to Risk Category I or II and the building is greater than two (2) stories above grade plane.
   4. Nominal design wind speed in excess o f49 m/sec 100 mph; and assigned to Risk Category III, IV, or V.
   5. Nominal design wind speed in excess of 49 mm/sec 100mph; and with a height greater than 23m 75ft.
   6. In addition to these conditions, the DOR is encouraged to consider using an SIOR on large magnitude or critical projects where this additional level of quality control is affordable.

I. Contracting Officer – The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

J. Contractor’s Quality Control (QC) Manager – An individual retained by the prime contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the contractor's QC organization.

K. Designer of Record (DOR) – A registered design professional is contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The DOR is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in state in which the design professional works. The DOR is also referred to as the Engineer of Record (EOR) in design code documents.

L. Statement of Special Inspections (SSI) – A document developed by the DOR identifying the material, systems, components and work required to have Special Inspections and covering the following:
   1. List of the Architectural Designated Seismic Systems – these components are in or attached to a Risk Category IV or V structure and are needed for continued operation of the facility or their failure could impair the continued operation of the facility.
   2. List of the Mechanical Designated Seismic Systems
      a. For Seismic Design Category C or Risk V, list the following:
         1) Heating, ventilation, and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork
         2) Piping systems and mechanical units containing flammable, combustible, or highly toxic materials.
      b. For Seismic Design Category D, E, or F or Risk Category V list mechanical system that meet one of the following:
         1) Life safety component required to function after an earthquake
         2) Component that contains hazardous content,

3) All components in an essential facility needed for continued operation after an earthquake.

3. List of the Electrical Designated Systems
   a. For Seismic Design Category C or Risk V, list the anchorage of electrical equipment used for emergency or standby power systems.
   b. For Seismic Design Category D, E or F list electrical system that meet one of the following:
      1) Life safety component required to function after an earthquake
      2) Component that contains hazardous content,
      3) All components in an essential facility needed for continued operation after an earthquake.
4. List of elements that are part of the progressive collapse resistance system.
   a. Provide a description of the following as they apply:
      1) Elements of the tie force system consisting of internal longitudinal and transverse, vertical, and peripheral tie.
      2) Elements of the alternate path system.
      3) Elements having enhanced local resistance. The Statement of Special Inspections and the Schedule of Special Inspections will be included as an attachment to this specification
         a) Schedule of Special Inspections – A schedule which lists each of the required Special Inspections, the extent to which each Special Inspections is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. Template found here:

SECTION 01 45 35
Schedule of SI Temp

SECTION 01 45 35
Statement of SI Tem

         b) Designated Seismic System – Those nonstructural components that require design in accordance with ASCE 7 Chapter 13 and for which the component importance factor, Ip, is greater than 1.0. This designation applies to systems that are required to be operational following the Design Earthquake for RC I - IV structures and following the MCER for RC V structures. All systems in RC V facilities designated as MC-1 in accordance with UFC 3-310-04 are considered part of the Designated Seismic Systems. Designated Seismic Systems will be identified by Owner and will have an Importance Factor Ip = 1.5

M. Submittals: Government approval is required for all submittals. CQC Special Inspection reports shall be submitted under this Specification section and follow the [Special Inspection]: [Applicable Specification section or description] naming convention. Submit the following:
1. SD-01 Preconstruction Submittals;
2. SIOR Letter of Acceptance;
3. Special Inspections Project Manual;
4. Special Inspections Agency's Written Practices
5. NDT Procedures and Equipment' Calibration Records;
6. SD-06 Test Reports;
7. Special Inspections
8. Daily Reports;
9. Special Inspections; Biweekly Reports;
10. SD-07 Certificates;
11. Fabrication Plant
12. Steel Truss Plant;
13. Wood Truss Plant;
14. AC472 Accreditation;
15. Steel Joist Institute Membership;

16. Precast Concrete Institute (PCI) Certified Plant;
17. Certificate of Compliance;
18. Special Inspector of Record Qualifications;
19. Special Inspector Qualifications;
20. Qualification Records for NDT technicians;
21. SD-11 Closeout Submittals;
22. Interim Final Report of Special Inspections;
23. Comprehensive Final Report of Special Inspections;

N. Special Inspector Qualifications: Submit qualifications for each SI, ASI, and the SIOR from the following certifying associations: Associated Air Balance Council (AABC); American Concrete Institute (ACI); Association of the Wall and Ceiling Industry (AWCI); American Welding Society (AWS); Factory Mutual (FM); International Code Council (ICC); Nondestructive Testing (NDT); National Institute for Certification in Engineering Technologies (NICET); Precast/Prestressed Concrete Institute (PCI); Post-Tensioning Institute (PTI); Underwriters Laboratories (UL). Qualifications should be in accordance with the following.

QUALIFICATIONS

Area	Special Inspector	Associated Special Inspector	SIOR
Steel Construction and High Strength Bolting	ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or Registered Professional Engineer with related experience.	Engineer-In-Training with one year of related experience.	
Welding Structural Steel (For highly complex steel use only AWS Certified Welding Inspectors)	ICC Welding Special Inspector certificate with one year of related experience or AWS Certified Welding Inspector	AWS Certified Associate Welding Inspector	
Nondestructive Testing of Welds	NDT Level II Certificate	NDT Level II Certificate plus one year of related experience	
Cold Formed Steel Framing	ICC Structural Steel and Bolting Special Inspector certificate with on year of related experience, or ICC Commercial Building Inspector with one year of experience; or Registered Professional Engineer with related experience.	Engineer-In-Training with one year of related experience.	

Area	Special Inspector	Associated Special Inspector	SIOR
Concrete Construction	ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or ACI Concrete Construction Special Inspector, or NICET Concrete Technician Level III Certificate in Construction Materials Testing, or, Registered Professional Engineer with related experience	ACI Concrete Construction Special Inspector in Training, or Engineer-In-Training with one year of related experience	
Prestressed Concrete Construction	ICC Pre-stressed Special Inspector Certificate with one year of related experience, or PCI Quality Control Technician/ Inspector Level II Certificate with one year of related experience, or Registered Professional Engineer with related experience.	PCI Quality Control Technician/ Inspector Level I Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Post-Tensioned Concrete Construction	PTI Level 2 Unbonded PT Inspector Certificate, or Registered Professional Engineer with related experience	PTI Level 1 Unbonded PT Inspector Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Masonry Construction	ICC Structural Masonry Special Inspector Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Wood	ICC Commercial Building Inspector Certificate with one year of related experience, or ICC Residential Building Inspector with on year of experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	

Area	Special Inspector	Associated Special Inspector	SIOR
Verification of Site Soil Condition, Fill Placement, and Load-Bearing Requirements	ICC Soils Special Inspector Certificate with one year of related experience, or NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience	NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction, or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Deep Foundations	NICET Soils Technician Level II Certificate in Construction Material Testing, or NICET Geotechnical Engineering Technician Level II Construction or Generalist Certificate, or Geologist-In-Training with one year of related experience, or Registered Professional Engineer with related experience	NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or Engineer-In-Training with one year of related experience	
Sprayed Fire Resistant Manual	ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Mastic and Intumescent Fire Resistant Coatings	ICC Spray-applied Fireproofing Special Inspector Certificate, or ICC Fire Inspector I Certificate with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	

Area	Special Inspector	Associated Special Inspector	SIOR
Exterior Insulation and Finish Systems (EIFS)	AWCI EIFS Inspector Certificate, or Exterior Design Institute Certificate, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience	
Fire-Resistant Penetrations and Joints	Passed the UL Firestop Exam with one year of related experience, or Passed the FM Firestop Exam with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	
Smoke Control	AABC Technician Certification with one year of related experience, or Registered Professional Engineer with related experience	Engineer-In-Training with one year of related experience.	
SIOR			Registered Professional Engineer

PART 2 - PRODUCTS

2.1 FABRICATORS SPECIAL INSPECTION

A. Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the applicable certification(s) from the following list to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

B. The following certifications meet the requirements for fabricator approval in accordance with paragraph 1704.2.5.2 of IBC:
   1. American Institute of Steel Construction (AISC) Certified Fabrication Plant, Category STD.
   2. Truss Plate Institute (TPI) steel truss plate quality assurance program certification.
   3. Truss Plate Institute (TPI) wood truss plate quality assurance program certification.
   4. International Accreditation Service, AC472 Accreditation Steel Joist Institute Membership
   5. Precast Concrete Institute (PCI) Certified Plant, Group C

C. At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special **Inspections, stating that the materials supplied and work performed by** the fabricator are in accordance the construction documents.

PART 3 - EXECUTION

3.1 RESPONSIBILIES MATRIX

Inspector	Responsibility	Condition
SIOR	a. Supervise all Special Inspectors required by the contract documents and the IBC. b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR. c. Verify the qualifications of all of the Special Inspectors. d. Verify the qualifications of fabricators.	Applicable when SIOR is required
	e. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following: 1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel. 2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection. f. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.	Applicable when SIOR is required and when the structural design is required to follow AISC341 for seismic design of steel structures
	g. Prepare a Special Inspections Project Manual, which will cover the following: 1. Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, General Contractor, Subcontractors, QC Manager, and DOR. 2. Organizational chart and/or communication plan, indicating lines of communication 3. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors. 4. Indicate the government reporting procedures. 5. Propose forms or templates to be used by SI and SIOR to document inspections. 6. Indicate procedures for tracking nonconforming work and verification that corrective work is complete. 7. Indicate how the SIOR and/or SI will participate in weekly QC meetings.	Applicable when SIOR is required

Inspector	Responsibility	Condition
	8. Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified per paragraph FABRICATOR SPECIAL INSPECTIONS. 9. Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work. Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval. h. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party. i. Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR. j. Submit a copy of the Special Inspector's daily reports to the QC Manager. k. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report. l. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following: 1. A brief summary of the work performed during the reporting time frame. 2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems, that were observed during the reporting period. 3. Discrepancies which were resolved or corrected. 4. A list of nonconforming items requiring resolution. 5. All applicable test results including nondestructive testing reports.	
QC Manager	a. If there is no SIOR, QC Manager must Supervise all Special Inspectors required by the contract documents and the IBC; Verify the qualifications of all of the Special Inspectors; Verify the	Applicable when SIOR is not required

Inspector	Responsibility	Condition
	qualifications of fabricators; Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR.	
	b. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.	n/a
Special Inspectors	a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections. b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.	
	c. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following: 1. The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel. 2. The agency's inspection procedures, including general inspection, material controls, and visual welding inspection. d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project. e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.]	Applicable when SIOR is NOT required and when the structural design is required to follow AISC 341 for seismic design of steel structures
	f. Submit a copy of the daily reports to the QC Manager. g. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report. h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following: 1. A brief summary of the work performed during the reporting time frame 2. Changes and/or discrepancies with the drawings, specifications, and mechanical or electrical component certification if they require seismic systems that were observed during the reporting period. 3. Discrepancies which were resolved or corrected. 4. A list of nonconforming items requiring resolution. 5. All applicable test result including nondestructive testing reports.	Applicable when SIOR is not required

Inspector	Responsibility	Condition
	j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.	
	k. Submit daily reports to the SIOR	Applicable when SIOR is required

3.2 DEFECTIVE WORK

A. Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Government to accept such work.

-- END OF SECTION –

SCHEDULE OF SPECIAL INSPECTIONS

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

INSPECTION DEFINITIONS:

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

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

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

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

DESIGNER NOTES (to be deleted after reviewing):

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

A. STRUCTURAL - STEEL – WELDING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

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

A. STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 2015 1705.2.1, AISC 360-10: Table C-N5.4-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	**PERFORM**	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	**PERFORM AND DOCUMENT**	✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	**PERFORM**	
18. k-area	**PERFORM**	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	**PERFORM**	
20. Repair activities	**PERFORM AND DOCUMENT**	
21. Document acceptance or rejection of welded joint or member	**PERFORM**	

END SECTION

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

B. STRUCTURAL - STEEL – BOLTING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

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

END SECTION

C. STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Section N5.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified nondestructive testing personnel	**PERFORM**	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	**[NOTE: DOR must delete this row if section D (SEISMIC PROVISIONS SECTION) is checked]** Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

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

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

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 341-10: Section J6.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: DOR may uncheck this section for projects NOT designed in accordance with AISC 341 (Seismic Provisions) or for projects designed according to AISC 341, but using an R value equal to 3]		
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	**PERFORM**	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	**DOCUMENT**	

END SECTION

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

E. STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION [1]

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table N6.1, AISC 341-10: Table J9-1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Placement and installation of steel headed stud anchors	**PERFORM**	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has been tied and supported as required	OBSERVE	

END SECTION

F. STRUCTURAL - STEEL - OTHER INSPECTIONS

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 341-10: Tables J8-1 & J10-1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	**PERFORM**	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	**DOCUMENT**	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	**DOCUMENT**	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	**DOCUMENT**	No holes or unapproved attachments made by the responsible contractor

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

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

END SECTION

G. STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

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

H. STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

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

I. STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

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

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

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

K. STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION

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

1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

L. STRUCTURAL - CONCRETE CONSTRUCTION SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

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

10. Pre-stressed concrete	**CONTINUOUS**	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

K. STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

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

END SECTION

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

M. STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

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

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

17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE **CONTINUOUS**	**[NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III]**

END SECTION

N. STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

O. STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: DOR may uncheck this section where sheathing nailing/fasteners (both shearwall and roof) are consistently greater than 4" on center, or if the design wind speed is less than 110 mph (49 meters/sec) AND the seismic design category is A or B]		
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors, braces, hold downs, roof and floor framing connections to exterior walls.

END SECTION

P. STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents

END SECTION

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

Q. GEOTECHNICAL - SOILS INSPECTION SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

R. GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	**CONTINUOUS**	
2. Inspect driving operations and maintain complete and accurate records for each element	**CONTINUOUS**	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achiever design capacity, record tip and butt elevations and document ay damage to foundation element	**CONTINUOUS**	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

S. GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

T. GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

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

END SECTION

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

U. FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION
THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

SPRAYED FIRE RESISTANT MATERIALS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.14		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Surface condition	OBSERVE	Prior to application confirm that surface has been prepared per the approved fire-resistance design and manufacturer's instructions.
2. Application	OBSERVE	Prior to application confirm that the substrate meets the minimum ambient temperature per the approved fire-resistance design and manufacturer's instructions.
3. Material thickness	OBSERVE	Verify that the thickness of the SFRM to structural elements is not less than the thickness require by the fire-resistant design in more that 10 percent of the measurement, but in no case less than minimum allowable thickness required by 1705.14.
4. Material density	OBSERVE	Verify that the thickness of the SFRM to structural elements is not less than the thickness require by the fire-resistant design in more than 10 percent of the measurement, but in no case less than minimum allowable thickness required by IBC 1705.14.5
5. Bond strength	OBSERVE	Verify cohesive/adhesive bond strength of the cured SFRM applied to the structural element is not less than 150psf and according to IBC 1705.14.6

END SECTION

V. FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION
THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.15		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Surface preparation	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B and the contract documents

END SECTION

W. FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION
THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.17		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	**[NOTE: This section applies to Risk Category III, IV, & V only. DOR may choose to uncheck this section where project is assigned to Risk**

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

2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	**Category I or II. Confirm Risk Category with Structural Engineer]**

END SECTION

X. FIRE PROTECTION – SMOKE CONTROL SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.17		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

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

Y. ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.16		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570. **[NOTE: not applicable to masonry or concrete wall applications. Uncheck this section in those cases]**

END SECTION

Z. ARCHITECTURAL – ARCHITECTURAL COMPONENTS

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: This section is not applicable to Seismic Design Categories A, B, & C. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with the structural engineer]		
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf**
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if height is less than 30 feet. Also, Interior non-load bearing walls need not be inspected if weighing less than 15psf**
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. **Inspector Note: Not required for racks less than 8 feet in height**

END SECTION

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

AA. PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

PLUMBING, MECHANICAL AND ELECTRICAL - DESIGNATED SEISMIC SYSTEMS IBC 1705.12.4		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: This section is not applicable to Seismic Design Categories A or B. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with structural engineer]		
1. Designated Seismic Systems equipment verification	OBSERVE	✓ Verify model number and serial number are in conformance with project specific seismic qualification (PSSQ) ✓ Verify Tag ID is correct and installed per specifications
2. Designated Seismic Systems equipment Mounting	OBSERVE	✓ Verify that Anchor Base Bolting is installed per PSSQ ✓ Verify that Equipment Bracing is Installed per PSSQ ✓ Verify that Bracing Attachments are installed per PSSQ
3. Designated Seismic Systems utility Conduit/Piping	OBSERVE	✓ Verify that Conduit/Piping is connected to the equipment per PSSQ (flex or rigid) ✓ Verify that Conduit/Piping is seismically supported independently of equipment and in accordance with PSSQ support requirements
4. Designated Seismic Systems clearance	OBSERVE	✓ Adjacent Equipment – Verify that there is adequate gap to eliminate possibility of pounding ✓ Conduit/Piping - Verify that there is adequate gap to eliminate possibility of pounding

END SECTION

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

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
   1. Adversely effect human health or welfare,
   2. Unfavorably alter ecological balances of importance to human life,
   3. Effect other species of importance to humankind, or;
   4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:
   1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
   2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
   3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
   4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
   5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
   6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
   7. Sanitary Wastes:
      a. Sewage: Domestic sanitary sewage and human and animal waste.
      b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES

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

B. U.S. National Archives and Records Administration (NARA):
   33 CFR 328 ..... Definitions

1.4 SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer's Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
   a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
   b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
   c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
   d. Description of the Contractor's environmental protection personnel training program.
   e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
   f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
   g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
   h. Permits, licenses, and the location of the solid waste disposal area.
   i. Environmental Monitoring Plans for the job site including land, water, air, and noise.
   j. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
   k. Inclusion of "best management practices" and methodologies.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted. Provide erosion control plans, in phases where required.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area

that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
   a. Box and protect from damage existing trees and shrubs to remain on the construction site.
   b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
   c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

C. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Texas and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
   1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
   2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
   3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
   4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

D. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
   1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

   2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:

a. Maintain maximum permissible construction equipment noise levels at 15 meter (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	80
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

b. Use shields or other physical barriers to restrict noise transmission.
c. Provide soundproof housings or enclosures for noise-producing machinery.
d. Use efficient silencers on equipment air intakes.
e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
f. Line hoppers and storage bins with sound deadening material.
g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.

E. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

F. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

G. - - - E N D - - -

SECTION 01 58 16
TEMPORARY INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies temporary interior signs.

PART 2 - PRODUCTS

2.1 TEMPORARY SIGNS

A. Fabricate from 50 Kg (110 pound) mat finish white paper.

B. Cut to 100 mm (4-inch) wide by 300 mm (12 inch) long size tag.

C. Punch 3 mm (1/8-inch) diameter hole centered on 100 mm (4-inch) dimension of tag. Edge of Hole spaced approximately 13 mm (1/2-inch) from one end on tag.

D. Reinforce hole on both sides with gummed cloth washer or other suitable material capable of preventing tie pulling through paper edge.

E. Ties: Steel wire 0.3 mm (0.0120-inch) thick, attach to tag with twist tie, leaving 150 mm (6-inch) long free ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temporary signs attached to room door frame or room door knob, lever, or pull for doors on corridor openings.

B. Mark on signs with felt tip marker having approximately 3 mm (1/8-inch) wide stroke for clearly legible numbers or letters.

C. Identify room with numbers as designated on floor plans.

3.2 LOCATION

A. Install on doors that have room, corridor, and space numbers shown.

B. Doors that do not require signs are as follows:
   1. Corridor barrier doors (cross-corridor) in corridor with same number.
   2. Folding doors or partitions.
   3. Toilet or bathroom doors within and between rooms.
   4. Communicating doors in partitions between rooms with corridor entrance doors.
   5. Closet doors within rooms.

C. Replace missing, damaged, or illegible signs.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.

C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:

D. Waste Management Plan development and implementation.

E. Techniques to minimize waste generation.

F. Sorting and separating of waste materials.

G. Salvage of existing materials and items for reuse or resale.

H. Recycling of materials that cannot be reused or sold.

I. At a minimum the following waste categories shall be diverted from landfills:
   1. Soil.
   2. Inerts (eg, concrete, masonry and asphalt).
   3. Clean dimensional wood and palette wood.
   4. Green waste (biodegradable landscaping materials).
   5. Engineered wood products (plywood, particle board and I-joists, etc).
   6. Metal products (eg, steel, wire, beverage containers, copper, etc).
   7. Sheathings
   8. Cardboard, paper and packaging.
   9. Bitumen roofing materials.
   10. Plastics (eg, ABS, PVC).
   11. Carpet and/or pad.
   12. Gypsum board.
   13. Insulation.
   14. Paint.
   15. Fluorescent lamps.

1.2 RELATED WORK

A. Section 02 41 00, DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
   1. Excess or unusable construction materials.
   2. Packaging used for construction products.
   3. Poor planning and/or layout.
   4. Construction error.
   5. Over ordering.
   6. Weather damage.
   7. Contamination.

8. Mishandling.
9. Breakage.

B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.

C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.

D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.

H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.

C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.

D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.

E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).

F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.

H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.

I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.

J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.

M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.

N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.

O. Return: To give back reusable items or unused products to vendors for credit.

P. Salvage: To remove waste materials from the site for resale or re-use by a third party.

Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.

R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.

S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

B. Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
1. Procedures to be used for debris management.
2. Techniques to be used to minimize waste generation.
3. Analysis of the estimated job site waste to be generated:
   a. List of each material and quantity to be salvaged, reused, recycled.
   b. List of each material and quantity proposed to be taken to a landfill.
4. Detailed description of the Means/Methods to be used for material handling.
   a. On site: Material separation, storage, protection where applicable.
   b. Off site: Transportation means and destination. Include list of materials.
      1) Description of materials to be site-separated and self-hauled to designated facilities.
      2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
         a) The names and locations of mixed debris reuse and recycling facilities or sites.
         b) The names and locations of trash disposal landfill facilities or sites.
         c) Documentation that the facilities or sites are approved to receive the materials.

C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.

D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

E. Target waste diversion rate by material and an overall diversion rate.

F. Final report documenting the results of implementation of the preconstruction waste management plan.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

B. U.S. Green Building Council (USGBC): LEED Green Building Rating System for New Construction
   1. Green Building Initiative (GBI): Green Globes for New Construction 2019

1.7 RECORDS

A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. List of each material and quantity to be salvaged, recycled, reused.

B. List of each material and quantity proposed to be taken to a landfill.

C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.

B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.

B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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SECTION 01 81 13

SUSTAINABLE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes general requirements and procedures to comply with federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable construction.

B. The Design Professional has selected materials and utilized integrated design processes that achieve the Government's objectives. Contractor is responsible to maintain and support these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes. Obtain approval from Contracting Officer for all changes and substitutions to materials or processes. Proposed changes must meet, or exceed, materials or processes specified.

1.2 RELATED WORK

A. Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

B. Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 DEFINITIONS

A. Recycled Content: Recycled content of materials is defined according to Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260). Recycled content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine recycled content value.
   1. "Post-Consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
   2. "Pre-Consumer" material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

B. Biobased Products: Biobased products are derived from plants and other renewable agricultural, marine, and forestry materials and provide an alternative to conventional petroleum derived products. Biobased products include diverse categories such as lubricants, cleaning products, inks, fertilizers, and bioplastics.

C. Low Pollutant-Emitting Materials: Materials and products which are minimally odorous, irritating, or harmful to comfort and well-being of installers and occupants.

D. Volatile Organic Compounds (VOC): Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.4 REFERENCE STANDARDS

A. Carpet and Rug Institute Green Label Plus program.

B. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

C. U.S. Environmental Protection Agency Comprehensive Procurement Guidelines (CPG).

D. U.S. Environmental Protection Agency WaterSense Program (WaterSense).

E. U.S. Environmental Protection Agency ENERGY STAR Program (ENERGY STAR).

F. U. S. Department of Energy Federal Energy Management Program (FEMP).

G. Green Electronic Council EPEAT Program (EPEAT).

1.5 SUBMITTALS

A. All submittals to be provided by contractor to COR.

B. Sustainability Action Plan:
1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
3. Sustainability Action Plan must:
   a. Make reference to sustainable construction submittals defined by this section.
   b. Address all items listed under PERFORMANCE CRITERIA.
   c. Indicate individual(s) responsible for implementing the plan.

C. Low Pollutant-Emitting Materials Tracking Spreadsheet: Within 30 days after Preconstruction Meeting provide a preliminary Low Pollutant-Emitting Materials Tracking Spreadsheet. The Low Pollutant-Emitting Materials Tracking Spreadsheet must be an electronic file and include all materials on Project in categories described under Low Pollutant-Emitting Materials in 01 81 13.

D. Construction Indoor Air Quality (IAQ) Management Plan:
1. Not more than 30 days after Preconstruction Meeting provide a Construction IAQ Management Plan as an electronic file including descriptions of the following:
   a. Instruction procedures for meeting or exceeding minimum requirements of ANSI/SMACNA 008-2008, Chapter 3, including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling.
   b. Instruction procedures for protecting absorptive materials stored on-site or installed from moisture damage.
   c. Schedule of submission of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials.
   d. Instruction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille.
   e. Instruction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit.
   f. Instruction procedures and schedule for implementing building flush-out.

E. Product Submittals:
1. Recycled Content: Submit product data from manufacturer indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content (excluding MEP systems equipment and components).
2. Biobased Content: Submit product data for products to be installed or used which are included in any of the USDA BioPreferred program’s product categories. Data to include percentage of biobased content and source of biobased material.
3. Low Pollutant-Emitting Materials: Submit product data confirming compliance with relevant requirements for all materials on Project in categories described under Low Pollutant-Emitting Materials in 01 81 13.
4. For applicable products and equipment, submit product documentation confirming ENERGY STAR label, FEMP certification, WaterSense, and/or EPEAT certification.

F. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, submit a Sustainable Construction Progress Report to confirm adherence with Sustainability Action Plan.
1. Include narratives of revised strategies for bringing work progress into compliance with plan and product submittal data.

2. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
3. Include construction waste tracking, in tons or cubic yards, including waste description, whether diverted or landfilled, hauler, and percent diverted for comingled quantities; and excluding land-clearing debris and soil. Provide haul receipts and documentation of diverted percentages for comingled wastes.

G. Closeout Submittals: Within 14 days after Substantial Completion provide the following:
1. Final version of Low Pollutant-Emitting Materials Tracking Spreadsheet.
2. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed air handling units are used during construction.
3. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for final filtration media in air handling units.
4. Minimum 18 construction photographs including six photographs taken on three different occasions during construction of ANSI/SMACNA 008-2008, Chapter 3 approaches employed, along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
5. Flush-out Documentation:
   a. Product data for filtration media used during flush-out.
   b. Product data for filtration media installed immediately prior to occupancy.
   c. Signed statement describing building air flush-out procedures including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

1.6 QUALITY ASSURANCE

A. Preconstruction Meeting: After award of Contract and prior to commencement of Work, schedule and conduct meeting with COR/Resident Engineer and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the Sustainable Construction Requirements and coordination of contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.

B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

C. Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

D. Green Seal Standard GC-36, Commercial Adhesives, October 19, 2000.

E. South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

F. South Coast Air Quality Management District (SCAQMD) Rule 1168, July 1, 2005 and rule amendment date of January 7, 2005.

G. Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition (ANSI/SMACNA 008-2008), Chapter 3.

H. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers,

Version 1.1, Emission Testing method for California Specification 01350 (CDPH Standard Method V1.1-2010).

I. Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260).

J. ASHRAE Standard 52.2-2007.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Construction waste diversion from landfill disposal must comprise at least 50 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal.

B. Low Pollutant-Emitting Materials:
1. Adhesives, sealants and sealant primers applied on site within the weatherproofing membrane must comply with VOC limits of SCAQMD Rule 1168:
   a. Flooring Adhesives and Sealants:
      1) Indoor carpet adhesives: 50 g/L.
      2) Wood Flooring Adhesive: 100 g/L.
      3) Rubber Floor Adhesives: 60 g/L.
      4) Subfloor Adhesives: 50 g/L.
      5) Ceramic Tile Adhesives and Grout: 65 g/L.
      6) Cove Base Adhesives: 50 g/L.
      7) Multipurpose Construction Adhesives: 70 g/L.
      8) Porous Material (Except Wood) Substrate: 50 g/L.
      9) Wood Substrate: 30 g/L.
      10) Architectural Non-Porous Sealant Primer: 250 g/L.
      11) Architectural Porous Sealant Primer: 775 g/L.
      12) Other Sealant Primer: 750 g/L.
      13) Structural Wood Member Adhesive: 140 g/L.
      14) Sheet-Applied Rubber Lining Operations: 850 g/L.
      15) Top and Trim Adhesive: 250 g/L.
      16) Architectural Sealant: 250 g/L.
      17) Other Sealant: 420 g/L.
   b. Non-Flooring Adhesives and Sealants:
      1) Drywall and Panel Adhesives: 50 g/L.
      2) Multipurpose Construction Adhesives: 70 g/L.
      3) Structural Glazing Adhesives: 100 g/L.
      4) Metal-to-Metal Substrate Adhesives: 30 g/L.
      5) Plastic Foam Substrate Adhesive: 50 g/L.
      6) Porous Material (Except Wood) Substrate Adhesive: 50 g/L.
      7) Wood Substrate Adhesive: 30 g/L.
      8) Fiberglass Substrate Adhesive: 80 g/L.
      9) Architectural Non-Porous Sealant Primer: 250 g/L.
      10) Architectural Porous Sealant Primer: 775 g/L.
      11) Other Sealant Primer: 750 g/L.
      12) PVC Welding Adhesives: 510 g/L.
      13) CPVC Welding Adhesives: 490 g/L.
      14) ABS Welding Adhesives: 325 g/L.
      15) Plastic Cement Welding Adhesives: 250 g/L.
      16) Adhesive Primer for Plastic: 550 g/L.
      17) Contact Adhesive: 80 g/L.
      18) Special Purpose Contact Adhesive: 250 g/L.
      19) Structural Wood Member Adhesive: 140 g/L.

20) Sheet Applied Rubber Lining Operations: 850 g/L.
21) Top and Trim Adhesive: 250 g/L.
22) Architectural Sealants: 250 g/L.
23) Other Sealants: 420 g/L.

2. Aerosol adhesives applied on site within the weatherproofing membrane must comply with the following Green Seal GS-36.
   a. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent VOCs by weight.
   b. Aerosol Adhesive, General-Purpose Web Spray: 55 percent VOCs by weight.
   c. Special-Purpose Aerosol Adhesive (All Types): 70 percent VOCs by weight.
3. Paints and coatings applied on site within the weatherproofing membrane must comply with the following criteria:
   a. VOC content limits for paints and coatings established in Green Seal Standard GS-11.
   b. VOC content limit for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates of 250 g/L established in Green Seal GC-03.
   c. Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed VOC content limits established in SCAQMD Rule 1113.
   d. Comply with the following VOC content limits:
      1) Anti-Corrosive/Antirust Paints: 250 g/L.
      2) Clear Wood Finish, Lacquer: 550 g/L.
      3) Clear Wood Finish, Sanding Sealer: 350 g/L.
      4) Clear Wood Finish, Varnish: 350 g/L.
      5) Floor Coating: 100 g/L.
      6) Interior Flat Paint, Coating or Primer: 50 g/L.
      7) Interior Non-Flat Paint, Coating or Primer: 150 g/L.
      8) Sealers and Undercoaters: 200 g/L.
      9) Shellac, Clear: 730 g/L.
      10) Shellac, Pigmented: 550 g/L.
      11) Stain: 250 g/L.
      12) Clear Brushing Lacquer: 680 g/L.
      13) Concrete Curing Compounds: 350 g/L.
      14) Japans/Faux Finishing Coatings: 350 g/L.
      15) Magnesite Cement Coatings: 450 g/L.
      16) Pigmented Lacquer: 550 g/L.
      17) Waterproofing Sealers: 250 g/L.
      18) Wood Preservatives: 350 g/L.
      19) Low-Solids Coatings: 120 g/L.
4. Carpet installed in building interior must comply with one of the following:
   a. Meet testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
   b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at the 14 day time point.
5. Each non-carpet flooring element installed in building interior which is not inherently non-emitting (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) must comply with one of the following:
   a. Meet requirements of the FloorScore standard as shown with testing by an independent third-party.
   b. Maximum VOC concentrations specified in CDPH Standard Method V1.1-2010, using office scenario at 14 day time point.
6. Composite wood and agrifiber products used within the weatherproofing membrane must contain no added urea-formaldehyde resins.
7. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde.

C. Recycled Content:
1. Any products being installed or used that are listed on EPA Comprehensive Procurement Guidelines designated product list must meet or exceed the EPA's recycled content recommendations. The EPA Comprehensive Procurement Guidelines categories include:
a. Building insulation.
b. Cement and concrete.
c. Consolidated and reprocessed latex paint.
d. Floor tiles.
e. Flowable fill.
f. Laminated paperboard.
g. Modular threshold ramps.
h. Nonpressure pipe.
i. Patio blocks.
j. Railroad grade crossing surfaces.
k. Roofing materials.
l. Shower and restroom dividers/partitions.
m. Structural fiberboard.
n. Nylon carpet and nylon carpet backing.
o. Compost and fertilizer made from recovered organic materials.
p. Hydraulic mulch.
q. Lawn and garden edging.
r. Plastic lumber landscaping timbers and posts.
s. Park benches and picnic tables.
t. Plastic fencing.
u. Playground equipment.
v. Playground surfaces.
w. Bike racks.

D. Biobased Content:
1. Materials and equipment being installed or used that are listed on the USDA BioPreferred program product category list must meet or exceed USDA's minimum biobased content threshold. Refer to individual specification sections for detailed requirements applicable to that section.
a. USDA BioPreferred program categories include:
1) Adhesive and Mastic Removers.
2) Carpets.
3) Cleaners.
4) Composite Panels.
5) Corrosion Preventatives.
6) Erosion Control Materials.
7) Dust Suppressants.
8) Fertilizers.
9) Floor Cleaners and Protectors.
10) Floor Coverings (Non-Carpet).
11) Glass Cleaners.
12) Hydraulic Fluids.
13) Industrial Cleaners.
14) Interior Paints and Coatings.
15) Mulch and Compost Materials.
16) Multipurpose Cleaners.
17) Multipurpose Lubricants.
18) Packaging Films.
19) Paint Removers.
20) Plastic Insulating Foam.
21) Pneumatic Equipment Lubricants.
22) Roof Coatings.

23) Wastewater Systems Coatings.
24) Water Tank Coatings.
25) Wood and Concrete Sealers.
26) Wood and Concrete Stains.

E. Materials, products, and equipment being installed which fall into a category covered by the WaterSense program must be WaterSense-labeled or meet or exceed WaterSense program performance requirements, unless disallowed for infection control reasons.
1. WaterSense categories include:
a. Bathroom Faucets
b. Commercial Toilets
c. Irrigation Controllers
d. Pre-Rinse Spray Valves
e. Residential Toilets
f. Showerheads
g. Spray Sprinkler Bodies
h. Urinals

F. Materials, products, and equipment being installed which fall into any of the following product categories must be Energy Star-labeled.
1. Applicable Energy Star product categories as of 09/14/2017 include:
a. Appliances:
1) Air Purifiers and Cleaners.
2) Clothes Dryers (Residential).
3) Clothes Washers (Commercial & Residential).
4) Dehumidifiers.
5) Dishwashers (Residential).
6) Freezers (Residential).
7) Refrigerators (Residential).
b. Electronics and Information Technology:
1) Audio/Video Equipment.
2) Computers.
3) Data Center Storage.
4) Digital Media Player.
5) Enterprise Servers.
6) Imaging Equipment.
7) Monitors.
8) Professional Displays.
9) Set-Top and Cable Boxes.
10) Telephones.
11) Televisions.
12) Uninterruptible Power Supplies.
13) Voice over Internet Protocol (VoIP) Phones.
c. Food Service Equipment (Commercial):
1) Dishwashers.
2) Fryers.
3) Griddles.
4) Hot Food Holding Cabinets.
5) Ice Makers.
6) Ovens.
7) Refrigerators and Freezers.
8) Steam Cookers.
9) Vending Machines.
d. Heating and Cooling Equipment:
1) Air-Source Heat Pumps (Residential).
2) Boilers.
3) Ceiling Fans (Residential).

4) Central Air Conditioners (Residential).
5) Ductless Heating and Cooling (Residential).
6) Furnaces (Residential).
7) Water Heaters.
8) Geothermal Heat Pumps (Residential).
9) Light Commercial Heating and Cooling Equipment.
10) Room Air Conditioners (Residential).
11) Ventilation Fans (Residential).

e. Other:
1) Decorative Light Strings.
2) Electric Vehicle Supply Equipment.
3) Laboratory-Grade Refrigerators and Freezers.
4) Light Bulbs.
5) Light Fixtures.
6) Pool Pumps.
7) Roof Products.
8) Water Coolers.
9) Windows, Doors, and Skylights.

G. Materials, products, and equipment being installed which fall into any of the following categories must be FEMP-designated. FEMP-designated product categories as of 09/14/2017 include:
1. Boilers (Commercial).
2. Dishwashers (Commercial).
3. Electric Chillers, Air-Cooled (Commercial).
4. Electric Chillers, Water-Cooled (Commercial).
5. Exterior Lighting.
6. Fluorescent Ballasts.
7. Fluorescent Lamps, General Service.
8. Ice Machines, Water-Cooled.
9. Industrial Lighting (High/Low Bay).
10. Light Emitting Diode (LED) Luminaires.

H. Electronic products and equipment being installed which fall into any of the following categories shall be EPEAT registered. Electronic products and equipment covered by EPEAT program as of 09/14/2017 include:
1. Computers.
2. Displays.
3. Imaging Equipment.
4. Televisions.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Construction Indoor Air Quality Management:
1. During construction, meet or exceed recommended control measures of ANSI/SMACNA 008-2008, Chapter 3.
2. Protect stored on-site and installed absorptive materials from moisture damage.
3. If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda). Replace all filtration media immediately prior to occupancy.
4. Perform building flush-out as follows:
a. After construction ends, prior to occupancy and with interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 degrees Fahrenheit and a relative humidity no higher than 60 percent. OR

b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it must be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or design minimum outside air rate determined until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space. During each day of flush-out period, ventilation must begin a minimum of three hours prior to occupancy and continue during occupancy.

-----END----

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING DESCRIPTION

A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 7, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:
   1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
   2. Verify and document proper integrated performance of equipment and systems.
   3. Verify that Operations & Maintenance documentation is complete.
   4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
   5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
   6. Document the successful achievement of the commissioning objectives listed above.

F. All equipment shall have 30 days documented error-free operation prior to scheduling Cx Functional Performance Testing.

G. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer

and the Resident Engineer as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.

B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to VA Resident Engineer and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the Resident Engineer and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the Resident Engineer.

C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.

D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and Resident Engineer. Thus, the procedures outlined in this specification must be executed within the following limitations:
   1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
   2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
   3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
   4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.
   5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 32.16.15 PROJECT SCHEDULES (SMALL PROJECTS – DESIGN/BID/BUILD)

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

D. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS

E. Section 21 08 00 COMMISSIONING OF FIRE PROTECTION SYSTEMS.

F. Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

G. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

H. Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS.

I. Section 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS.

J. Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.4 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

C. The commissioning activities have been developed to support the United States Green Building Council's (USGBC) LEED ™ rating program and to support delivery of project performance in accordance with the VA requirements developed for the project to support the following credits:
1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" and the prerequisite of "Fundamental Building Systems Commissioning."
2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

D. The commissioning activities have been developed to support the Green Buildings Initiative's Green Globes rating program and to support delivery of project performance in accordance with the VA requirements developed for the project.

1.5 ACRONYMS

List of Acronyms	
Acronym	Meaning
A/E	Architect / Engineer Design Team
AHJ	Authority Having Jurisdiction
ASHRAE	Association Society for Heating Air Condition and Refrigeration Engineers
BOD	Basis of Design
BSC	Building Systems Commissioning
CCTV	Closed Circuit Television
CD	Construction Documents
CMMS	Computerized Maintenance Management System
CO	Contracting Officer (VA)
COR	Contracting Officer's Representative (see also VA-RE)
COBie	Construction Operations Building Information Exchange
CPC	Construction Phase Commissioning
Cx	Commissioning
CxA	Commissioning Agent
CxM	Commissioning Manager
CxR	Commissioning Representative
DPC	Design Phase Commissioning
FPT	Functional Performance Test
GBI-GG	Green Building Initiative - Green Globes

List of Acronyms	
Acronym	Meaning
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
NC	Department of Veterans Affairs National Cemetery
NCA	Department of Veterans Affairs National Cemetery Administration
NEBB	National Environmental Balancing Bureau
O&M	Operations & Maintenance
OPR	Owner's Project Requirements
PFC	Pre-Functional Checklist
PFT	Pre-Functional Test
SD	Schematic Design
SO	Site Observation
TAB	Test Adjust and Balance
VA	Department of Veterans Affairs
VAMC	VA Medical Center
VA CFM	VA Office of Construction and Facilities Management
VACO	VA Central Office
VA PM	VA Project Manager
VA-RE	VA Resident Engineer
USGBC	United States Green Building Council

1.6 DEFINITIONS

A. **Acceptance Phase Commissioning:** Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

B. **Accuracy:** The capability of an instrument to indicate the true value of a measured quantity.

C. **Back Check:** A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

D. **Basis of Design (BOD):** The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

E. **Benchmarks:** Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself.. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

F. **Building Information Modeling (BIM):** Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D, and provides reports both in 2D views and as schedules. This electronic information can be extracted and

reused for pre-populating facility management CMMS systems. Building Systems Commissioning (BSC): NEBB acronym used to designate its commissioning program.

G. **Calibrate:** The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

H. **CCTV:** Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

I. **COBie:** Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (http://www.wbdg.org/resources/cobie.php)

J. **Commissionability:** Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned

K. **Commissioning Agent (CxA):** The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

L. **Commissioning Checklists:** Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

M. **Commissioning Design Review:** The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

N. **Commissioning Issue:** A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also – Commissioning Observation).

O. **Commissioning Manager (CxM):** A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

P. **Commissioning Observation:** An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Q. **Commissioning Plan:** A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

R. **Commissioning Process:** A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

S. **Commissioning Report:** The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the

commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

T. **Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.**

U. **Commissioning Specifications:** The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

V. **Commissioning Team:** Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

W. **Construction Phase Commissioning:** All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

X. **Contract Documents (CD):** Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Y. **Construction Phase Commissioning (CPC):** All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Z. **Coordination Drawings:** Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

AA. **Data Logging:** The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

BB. **Deferred System Test:** Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

CC. **Deficiency:** See "Commissioning Issue".

DD. **Design Criteria:** A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

EE. **Design Intent:** The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

FF. **Design Narrative:** A written description of the proposed design solutions that satisfy the requirements of the OPR.

GG. **Design Phase Commissioning (DPC):** All commissioning tasks executed during the design phase of the project.

HH. **Environmental Systems:** Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

II. **Executive Summary:** A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

JJ. **Functionality:** This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

KK. **Functional Test Procedure (FTP):** A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

LL. **Industry Accepted Best Practice:** A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

MM. **Installation Verification:** Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

NN. **Integrated System Testing:** Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.
Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

OO. **Lessons Learned Workshop:** A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

PP. **Maintainability:** A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

QQ. **Manual Test:** Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the ‘observation’).

RR. **Owner’s Project Requirements (OPR):** A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

SS. **Peer Review:** A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

TT. **Precision:** The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

UU. **Pre-Design Phase Commissioning:** Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

VV. **Pre-Functional Checklist (PFC):** A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

WW. **Pre-Functional Test (PFT):** An inspection or test that is done before functional testing. PFT’s include installation verification and system and component start up tests.

XX. **Procedure or Protocol:** A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

YY. **Range:** The upper and lower limits of an instrument's ability to measure the value of a quantity for which the instrument is calibrated.

ZZ. **Resolution:** This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

AAA. **Site Observation Visit:** On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

BBB. **Site Observation Reports (SO):** Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

CCC. **Special System Inspections:** Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

DDD. **Static Tests:** Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

EEE. **Start Up Tests:** Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

FFF. **Systems Manual:** A system-focused composite document that includes all information required for the owners operators to operate the systems.

GGG. **Test Procedure:** A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

HHH. **Testing:** The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

III. **Testing, Adjusting, and Balancing (TAB):** A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

JJJ. **Thermal Scans:** Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

KKK. **Training Plan:** A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

LLL. **Trending:** Monitoring over a period of time with the building automation system.

MMM. **Unresolved Commissioning Issue:** Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the VA. Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of

interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).

3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

NNN. **Verification:** The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

OOO. **Warranty Phase Commissioning:** Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

PPP. **Warranty Visit:** A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

QQQ. **Whole Building Commissioning:** Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

1.7 SYSTEMS TO BE COMMISSIONED

A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

Systems To Be Commissioned	
System	**Description**
Fire Suppression	
Fire Suppression Systems	Wet pipe system, dry pipe system, pre-action system, special agent systems
HVAC	
Noise and Vibration Control	Noise and vibration levels for critical equipment such as Air Handlers, CRAC Units, etc. will be commissioned as part of the system commissioning
Direct Digital Control System**	Operator Interface Computer, Operator Work Station (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
Chilled Water System**	Chillers (centrifugal, rotary screw, air-cooled), pumps (primary, secondary, variable primary), VFDs associated with chilled water system components, DDC Control Panels (including integration with Building Control System)

Systems To Be Commissioned	
System	**Description**
HVAC Air Handling Systems**	Air handling Units, packaged rooftop AHU, Outdoor Air conditioning units, humidifiers, DDC control panels
HVAC Ventilation/Exhaust Systems	General exhaust, toilet exhaust, laboratory exhaust, isolation exhaust, room pressurization control systems
HVAC Terminal Unit Systems**	VAV Terminal Units, CAV terminal units, fan coil units, fin-tube radiation, unit heaters
Decentralized Unitary HVAC Systems*	Split-system HVAC systems, controls, interface with facility DDC, CRAC Units
Humidity Control Systems	Humidifiers, de-humidifiers, controls, interface with facility DDC
Hydronic Distribution Systems	Pumps, DDC control panels, heat exchangers,
Electrical	
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Electric Power Monitoring Systems	Metering, sub-metering, power monitoring systems, PLC control systems
Electrical System Protective Device Study	Review reports, verify field settings consistent with Study
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc)
Lighting & Lighting Control** Systems	Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	Witness 3rd party testing, review reports
Public Address & Mass Notification Systems	Witness 3rd party testing, review reports

Systems To Be Commissioned	
System	**Description**
Intercom & Program Systems	Witness 3rd party testing, review reports
Electronic Safety and Security	
Grounding & Bonding	Witness 3rd party testing, review reports
Physical Access Control Systems	Witness 3rd party testing, review reports
Video Surveillance System	Witness 3rd party testing, review reports
Fire Detection and Alarm System	100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems.
Table Notes	
** Denotes systems that LEED requires to be commissioned to comply with the LEED Fundamental Commissioning pre-requisite.	

1.8 COMMISSIONING TEAM

A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by Contractor:
   1. Contractor' Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
   2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

C. Members Appointed by VA:
   1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.
   2. User: Representatives of the facility user and operation and maintenance personnel.
   3. A/E: Representative of the Architect and engineering design professionals.

1.9 VA'S COMMISSIONING RESPONSIBILITIES

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A. Appoint an individual, company or firm to act as the Commissioning Agent.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
   1. Coordination meetings.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Testing meetings.
   4. Witness and assist in Systems Functional Performance Testing.
   5. Demonstration of operation of systems, subsystems, and equipment.

C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.10 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.

B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.

C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
1. Participate in commissioning coordination meetings.
2. Conduct operation and maintenance training sessions in accordance with approved training plans.
3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
5. Review and comment on commissioning documentation.
6. Participate in meetings to coordinate Systems Functional Performance Testing.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
8. Provide information to the Commissioning Agent for developing commissioning plan.
9. Participate in training sessions for VA's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT’S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.

C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.

E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The

Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.

G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.

H. Coordinate Systems Functional Performance Testing schedule with the Contractor.

I. Witness selected systems startups.

J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.

K. Witness and document Systems Functional Performance Testing.

L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 00 00 GENERAL REQUIREMENTS.

N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.

O. Prepare commissioning Field Observation Reports.

P. Prepare the Final Commissioning Report.

Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.12 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
3. Identification of systems and equipment to be commissioned.
4. Schedule of Commissioning Coordination meetings.
5. Identification of items that must be completed before the next operation can proceed.
6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.

8. Description of requirements for operation and maintenance training.
9. Schedule for commissioning activities with dates coordinated with overall construction schedule.
10. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
11. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
12. Preliminary Systems Functional Performance Test procedures.

B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
1. Name and identification code of tested system.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Observations and Issues.
8. Issue number, if any, generated as the result of test.

C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.
1. Creating an Commissioning Issues Log Entry:

a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
b. Assign a descriptive title for the issue.
c. Identify date and time of the issue.
d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
e. Identify system, subsystem, and equipment to which the issue applies.
f. f. Identify location of system, subsystem, and equipment.
g. Include information that may be helpful in diagnosing or evaluating the issue.
h. Note recommended corrective action.
i. Identify commissioning team member responsible for corrective action.
j. Identify expected date of correction.
k. Identify person that identified the issue.

2. Documenting Issue Resolution:
a. Log date correction is completed or the issue is resolved.
b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
c. Identify changes to the Contract Documents that may require action.
d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
e. Identify person(s) who corrected or resolved the issue.
f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:
1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
5. Commissioning Issues Log.
6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.

H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:
1. Documentation of deferred and off season test(s) results.
2. Completed Systems Functional Performance Test Procedures for off season test(s).
3. Documentation that unresolved system performance issues have been resolved.
4. Updated Commissioning Issues Log, including status of unresolved issues.
5. Identification of potential Warranty Claims to be corrected by the Contractor.

I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:
   1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
   2. Reference to Final Commissioning Plan.
   3. Reference to Final Commissioning Report.
   4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.13 SUBMITTALS

A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:
   1. The Commissioning Team: A list of commissioning team members by organization.
   2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
   3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
   4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
   5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
   6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
   7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.

E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.

F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA Resident Engineer with copies to the Contractor and Architect.

G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.

H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.

I. Data for Commissioning:
1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.
2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.14 COMMISSIONING PROCESS

A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.

B. Within 30 days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within 30 days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning

Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 ^{o}C (1.0 ^{o}F) and a resolution of + or - 0.1 ^{o}C (0.2 ^{o}F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Construction Commissioning Kick Off meeting	L	A	P	P	O	
	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Controls Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.	L	A	P	P	N/A	
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O	
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Document Reviews	TAB Plan Review	L	A	R	R	O	
	Submittal and Shop Drawing Review	R	A	R	L	O	
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A	
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A	
Site Observations	Witness Factory Testing	P	A	P	L	O	
	Construction Observation Site Visits	L	A	R	R	O	
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O	
	Final Functional Performance Test Protocols	L	A	R	R	O	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	

B. B. The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

C.

Acceptance Phase Commissioning Roles & Responsibilities		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Commissioning Meetings	L	A	P	P	O	
	Project Progress Meetings	P	A	P	L	O	
	Pre-Test Coordination Meeting	L	A	P	P	O	
	Lessons Learned and Commissioning Report Review Meeting	L	A	P	P	O	
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O	
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O	
Schedules	Prepare Functional Test Schedule	L	A	R	R	O	
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O	
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O	
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O	
	Pre-Functional Checklist Verification	L	A	R	R	O	
	Review Operations & Maintenance Manuals	L	A	R	R	R	
	Training Plan Review	L	A	R	R	R	
	Warranty Review	L	A	R	R	O	
	Review TAB Report	L	A	R	R	O	

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Site Observations	Construction Observation Site Visits	L	A	R	R	O	
	Witness Selected Equipment Startup	L	A	R	R	O	
Functional Test Protocols	TAB Verification	L	A	R	R	O	
	Systems Functional Performance Testing	L	A	P	P	P	
	Retesting	L	A	P	P	P	
Technical Activities	Issues Resolution Meetings	P	A	P	L	O	
	Systems Training	L	S	R	P	P	
Reports and Logs	Status Reports	L	A	R	R	O	
	Maintain Commissioning Issues Log	L	A	R	R	O	
	Final Commissioning Report	L	A	R	R	R	
	Prepare Systems Manuals	L	A	R	R	R	

D. C. The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

Warranty Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Meetings	Post-Occupancy User Review Meeting	L	A	O	P	P	

Warranty Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M					L = Lead P = Participate A = Approve R = Review O = Optional
Commissioning Roles & Responsibilities							
Category	Task Description	CxA	RE	A/E	PC	O&M	Notes
Site Observations	Periodic Site Visits	L	A	O	O	P	
Functional Test Protocols	Deferred and/or seasonal Testing	L	A	O	P	P	
Technical Activities	Issues Resolution Meetings	L	S	O	O	P	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	L	A		R	P	
Reports and Logs	Final Commissioning Report Amendment	L	A		R	R	
	Status Reports	L	A		R	R	

3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
   a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
   b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.
2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
   a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
   b. The full startup plan shall at a minimum consist of the following items:
      1) The Pre-Functional Checklists.
      2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
      3) The manufacturer's normally used field checkout sheets.
   c. The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.
   d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.
3. Sensor and Actuator Calibration
   a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.
   b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
4. Execution of Equipment Startup
   a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
   b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
   c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
   d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.

B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.

C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.4 PHASED COMMISSIONING

A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.5 DDC SYSTEM TRENDING FOR COMMISSIONING

A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.

B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers – Critical, Priority, and Maintenance.
   1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.
   2. Priority level alarms are to be printed to a printer which is connected to the Operator’s Work Station located within the engineer’s office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.
   3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer’s office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical

reports shall be submitted to the Resident Engineer and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing – Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the Resident Engineer. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the Resident Engineer, prior to the execution of Systems Functional Performance Testing.
2. Dynamic plotting – The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.
3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.
4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.

E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the Resident Engineer and Commissioning Agent.
   1. Point-to-Point checkout documentation;
   2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
   3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document

containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.

SYSTEM		
Sensor	**Calibration Frequency**	**O&M Calibration Procedure Reference**
Discharge air temperature	Once a year	Volume I Section D.3.aa
Discharge static pressure	Every 6 months	Volume II Section A.1.c

4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:
1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment

4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments.
16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
   1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
   2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
   3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
   4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
   5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.

B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.
   1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
   2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.
   3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
   4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:

a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.
b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
   a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
   b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
   c. The Commissioning Agent will document the resolution process.
   d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:
   1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
   2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
   3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
   4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
   5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will

evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.

B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's Resident Engineer, VA’s Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:
   1. Review the Contract Documents.
   2. Review installed systems, subsystems, and equipment.
   3. Review instructor qualifications.
   4. Review instructional methods and procedures.
   5. Review training module outlines and contents.
   6. Review course materials (including operation and maintenance manuals).
   7. Review and discuss locations and other facilities required for instruction.
   8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
   9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:
   1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
   2. Qualification Data: Submit qualifications for facilitator and/or instructor.
   3. Attendance Record: For each training module, submit list of participants and length of instruction time.

4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
5. Demonstration and Training Recording:
    a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
    b. Video Format: Provide high quality color DVD color on standard size DVD disks.
    c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
    d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    e. Submit two copies within seven days of end of each training module.
6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. Quality Assurance:
    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 Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
    c. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

E. Training Coordination:
1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. Instruction Program:
1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
    a. Fire protection systems, including fire alarm, fire pumps, and fire suppression systems.
    b. Intrusion detection systems.
    c. Conveying systems, including elevators, wheelchair lifts, escalators, and automated materials handling systems.
    d. Medical equipment, including medical gas equipment and piping.
    e. Laboratory equipment, including laboratory air and vacuum equipment and piping.
    f. Heat generation, including boilers, feedwater equipment, pumps, steam distribution piping, condensate return systems, heating hot water heat exchangers, and heating hot water distribution piping.

g. Refrigeration systems, including chillers, cooling towers, condensers, pumps, and distribution piping.
h. HVAC systems, including air handling equipment, air distribution systems, and terminal equipment and devices.
i. HVAC instrumentation and controls.
j. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
k. Packaged engine generators, including synchronizing switchgear/switchboards, and transfer switches.
l. Lighting equipment and controls.
m. Communication systems, including intercommunication, surveillance, nurse call systems, public address, mass evacuation, voice and data, and entertainment television equipment.
n. Site utilities including lift stations, condensate pumping and return systems, and storm water pumping systems.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.
2. 2. Documentation: Review the following items in detail:
a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project Record Documents.
e. Identification systems.
f. Warranties and bonds.
g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

H. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
   a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.
   b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
      1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
      2) The VA will furnish an instructor to describe VA's operational philosophy.
      3) The VA will furnish the Contractor with names and positions of participants.
3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:
1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
2. Video Format: Provide high quality color DVD color on standard size DVD disks.

3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

----- END -----

SECTION 01 91 00.A
COMMISSIONING PLAN

PART 1 - GENERAL

I. Introduction

A. The Department of Veterans Affairs (VA) is committed to commissioning new facilities and systems required for the reliable, safe, and secure operation of the **EHRM Infrastructure Upgrades, Main Computer Room Modernization at the Minneapolis VA Medical Center, Minneapolis, MN**. This process will verify that systems are complete and functioning properly upon project completion.

B. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify that systems are complete and functioning properly upon project completion.

C. This document is intended to be a roadmap for the parties involved in the Commissioning process. The document will explain the systems to be commissioned, the process activities, the procedures to follow throughout the commissioning process, and the roles and responsibilities for each party involved. The commissioning activities will begin during the design phase of the project and proceed through the construction period.

D. The team members for this project are committed to commissioning this facility and systems required for the reliable, safe, and secure operation of the Facility. This process is intended to verify that systems are properly installed, configured and operating in accordance with the requirements of the project.

E. For this project, the Department of Veterans Affairs establishes AE Design contracts for Design Phase and Construction Period Services. The Department also establishes a construction contract with a Prime Contractor to provide construction services. Both contracts are administered by a VA Contracting Officer and his/her designated representative. During the Design Phase, this representative is the Project Manager; during the construction phase, it is the Contracting Officer's Representative. On every project, the authority to modify any contract is strictly limited to the Contracting Officer and his/her designated representative.

F. In this structure, all communications on contractual issues are strictly limited to communications between the VA and these two prime contractors (AE Team and Prime Contractor). It is the practice of the VA to require that communication between other parties to the contracts (AE Subconsultants, Subcontractors and Vendors) be routed through these two prime contractors and the VA.

G. Whole Building Commissioning is a process that relies upon high levels of communications and collaboration between all parties to the construction process. By its nature, the levels of communication and cooperation between the Commissioning Authority and all other parties to the construction process (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort. In the absence of the relationships, cooperation and support created by this communication, the Commissioning Process will likely fail to achieve its ends.

H. With this fundamental conflict in mind, this Commissioning Plan has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and his/her Designated Representative. Thus, all procedures outlined in this manual must be executed within the following limitations:

1. The Commissioning Agent may maintain a continuous open communication with the AE team, including sub-consultants, the Contractor and subcontractors and the Owner's team to facilitate a collaborative commissioning process subject to the specific limitations outlined below.

2. All information from the Commissioning Agent to any party to the project must be transmitted with the following clear limitations:

    a. No communications (verbal or written) will be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and any party to the construction project.

    b. In the event that any Commissioning Issues and suggested resolutions are deemed to require either an official interpretation of the construction documents or are determined to require a modification of the contract documents, Contracting Officer or designated COR will issue an official directive to this effect.

    c. All parties to the Commissioning Process shall be individually responsible for alerting the COR of any issues that they deem to constitute a potential contract change prior to acting on these issues.

d. Authority for design and construction issues resolution rests solely with the Contracting Officer and his/her designated representative with appropriate technical guidance from the AE Team and/or Commissioning Agent.

I. Abbreviations

1. Operations and Maintenance (O&M)
2. Architect (A)
3. VAMC Project Manager (PM)
4. VAMC Facilities Management Department Staff (FMD)
5. Design Professionals (D)
6. Contracting Officer's Representative (COR)
7. Construction Manager (CPM)
8. Installation Contractors (CONTR)
9. Testing, Adjusting & Balancing Contractor (TAB)
10. Commissioning Authority (CxA)
11. Request for Information (RFI)
12. Architect's Supplemental Instructions (ASI)
13. Design Development Documents (DD)
14. Construction Documents (CD)
15. Commissioning (Cx)
16. Functional Performance Test (FPT)
17. Pre-Functional Checklist (PFC)
18. Corrective Action Notice (CAR)
19. Quality Control (QC)

II. Definitions

A. Basis of Design Document (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes

both narrative descriptions and lists of individual items that support the design process.

B. Commissioning (Cx): Commissioning is the process of ensuring that all building systems perform interactively according to the design intent and the installed systems meet the Owner's operational needs.

C. Construction Documents: generally, the project design and specifications that dictate the installation.

D. Contract Documents: The documents governing the relationships between parties involved in the design and construction of this project including Agreements/Contracts, Construction Plans, Specifications, Addenda, Change Orders, Commissioning Plan.

E. Commissioning Issues Log: A formal and ongoing record of issues or concerns, and their resolutions that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

F. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

G. Commissioning Process: A systematic process of ensuring that building systems perform interactively according to the contract documents, the design intent, and districts operational requirements. The commissioning process encompasses and coordinates traditionally separate functions of systems documentation, equipment, startup, control system calibration, testing and balancing, performance testing and training.

H. Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

I. Construction Phase Commissioning: All commissioning efforts are executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

J. Contractor: As used herein is a general reference to the applicable installation party and can therefore refer to the Prime Contractor, subcontractors, or vendors.

K. Deficiency: An installation or condition that is not in conformance with the construction documents and/or the design intent.

L. Functional Completion: A milestone that marks the completion of the Acceptance Phase and successful completion of the FPT.

M. Functional Performance Testing: The detailed and thorough testing of the building systems and their interactions with the building components and other building systems.

N. Commissioning Agent (CxA): The Commissioning Firm's designated individual to coordinate, manage and execute the commissioning process.

O. Owner's Project Requirements: A written document that details the functional requirements of the project and the expectations of how the building will be used and operated. This includes the project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

P. Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Q. Start Up: Typically used to refer to the static testing or check out of systems or equipment to ensure that they are complete, properly installed, and ready for dynamic testing.

R. Trending: Monitoring and recording a history of parameters typically using the facility management system.

S. Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

T. Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating, and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates.

U. Training Plan: A written document that details the expectations, schedule, and deliverables of Commissioning Process activities related to the training of project operating and maintenance personnel, users, and occupants.

V. Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

III. Commissioning Goals

A. The Commissioning Authority has developed specific Commissioning Goals to emphasize the role commissioning will play in the design and construction processes:

1. Meet or exceed VAMC Project Requirements
2. Optimize Systems Operations
3. System operation and performance verification
    a. Performance Test results
    b. Pre-Functional checklists
    c. Equipment startup
4. Integrate Testing Schedules into Construction Schedule
    a. Coordination of trades
    b. Coordination of DDC vendor tasks
    c. Coordination of TAB vendor tasks
5. Early identification and resolution of issues
6. Clear and open communications

B. Related Specifications:

1. 01 00 00 General Requirements
2. 01 32 23 Shop Drawings, Product Data, and Samples
3. 21 08 00 Commissioning of Fire Protection Systems
4. 22 08 00 Commissioning of Plumbing Systems
5. 23 08 00 Commissioning of HVAC Systems
6. 26 08 00 Commissioning of Electrical Systems
7. 27 08 00 Commissioning of Communication Systems
8. 28 08 00 Commissioning of Electronic Safety and Security System

IV. Project Description

A. This project provides renovation of the Main Computer Room (MCR) within at the Minneapolis Healthcare System Campus. This project shall include all materials and labor to renovate/consolidate and provide new utility infrastructure on this project.

The goals of this project are:

1. Consolidate and renovate the existing Data Center space, 2B-105 and BH-111/BG-111.
2. Provide phasing to ensure no network downtime, coordinated with ISTS, HEFP and DCIE standards.
3. Coordinate Solutions with the VA staff to ensure minimal impact to existing space function and capacity and minimize down-time to services provided.
4. All construction shall be performed in accordance with VA Directive 7715.
5. The contractor shall perform all work after-hours and weekends. No work shall occur during normal hours of operation.

V. Commissioning Scope

A. Triple C – The A&E Group will provide commissioning services to support the '**EHRM Infrastructure Upgrades at the Minneapolis VA Medical Center** project. Commissioning activities will include the tasks and deliverables outlined below.

Commissioning Scope			
Project Phase	**Task**	**Description**	**Deliverable**
Design	Review Owner's Project Requirements	Review VAMC Design Criteria and Owner's Project Requirement document. .	N/A
Design	Commissioning Specifications	Prepare Commissioning Specification "Section 01 91 00 – General Commissioning Requirements" to be included in project manual.	Commissioning Specification
		Prepare Commissioning Specifications to provide detailed commissioning, operations & maintenance and training requirements for individual technical specification sections.	Commissioning Specifications
Design	Preliminary Commissioning Plan	Prepare Preliminary Commissioning Plan that describes the Commissioning Process, Commissioning Team with specific Roles and Responsibilities. The Commissioning Plan will include description of systems to be commissioned.	Preliminary Commissioning Plan

Commissioning Scope			
Project Phase	**Task**	**Description**	**Deliverable**
Construction	Final Commissioning Plan	Based on the final construction documents, update the Preliminary Commissioning Plan to identify specific systems to be commissioned. The Final Commissioning Plan will also include specific individual roles and responsibilities and Preliminary Pre-Functional Checklists and Functional Test Plans for systems to be commissioned.	Final Commissioning Plan.
Construction	Submittal and Shop Drawing Review	Based on final construction documents, prepare a list of selected submittals and shop drawings for review by the Commissioning Authority. Review selected submittals and shop drawings to support the commissioning process. The review will be for the purpose of developing appropriate Pre-Functional Checklists and Functional Test Plans. Reviews will focus on the ability to commission the systems, maintainability and general conformance to owner's requirements. Commissioning review of submittals and shop drawings does not replace the Design Team responsibility for approval.	Submittal Request Checklist. Commissioning Submittal Review Log

Commissioning Scope			
Project Phase	**Task**	**Description**	**Deliverable**
Construction	Pre-Functional Checklists	Prepare Pre-Functional Checklists for systems, components and/or equipment to be commissioned. These Pre-Functional Checklists will be used to document completion of system, component and/or equipment installation and to determine system readiness for functional testing. Pre-Functional Checklists should be completed by the installing contractors to document the installation process. Completed Pre-Functional Checklists are to be submitted to the commissioning authority a minimum of seven days prior to testing. Completed Systems Readiness Checklists will be spot checked by the commissioning authority to verify systems are ready for testing.	Draft Pre-Functional Checklists for owner and contractor review. Final Pre-Functional Checklists for use by contractors and/or CxA.
Construction	Prepare Functional Test Plans	Based on final construction documents (including applicable changes), and approved submittals, prepare Functional Test Plans for systems to be commissioned. Draft Functional Test Plans will be issued for review by the owner, installing contractors and DDC Vendor. Final Functional Test Plans will be prepared incorporating review comments received from owner, contractors or DDC Vendor.	Draft Functional Test Plans for review by owner, installing contractors and DDC vendor. Final Functional Test Plans for use in systems testing.

Construction	TAB Review	Review HVAC systems Test and Balance Plan prepared by the TAB vendor. Review will be to determine general conformance with owner's requirements.	Commissioning Review Log

Commissioning Scope			
Project Phase	**Task**	**Description**	**Deliverable**
		Review TAB Report prepared by TAB vendor following system air and water balancing. Review will be focused on TAB results that affect system performance and/or commissioning. Specific attention will be given to equipment installation and operational issues identified by the TAB vendor.	Commissioning Issues Log
Construction	Systems Functional Testing	Direct functional testing for systems to be commissioned. Testing will be conducted as detailed on the specific Functional Test Plan for each system to be commissioned. Functional testing will require support from the owner, mechanical contractor, electrical contractor, DDC Vendor, TAB Vendor, and specialty-systems installing contractors. Installing contractors must be available to respond to issues and problems identified during testing.	Executed Functional Test Plans. Commissioning Issues Log

Commissioning Scope			
Project Phase	**Task**	**Description**	**Deliverable**
Construction	Final Commissioning Report	Compile a comprehensive commissioning report documenting all commissioning activities, including but not limited to: ● Commissioning scope ● Test methods and results. ● Outstanding commissioning issues ● Issues log ● Commissioning plan ● Status reports ● Submittal and O&M manual reviews ● Pre-Functional Checklists ● Design Review Comments Scope includes one submission of a preliminary report for owner review. Scope includes one submission of the Final Commissioning Report that incorporates owners review comments.	Preliminary Commissioning Report – for owner review. Final Commissioning Report
Construction	Master Issues Log	Maintain a Commissioning Issues Log to document commissioning issues identified during construction and functional testing. The Commissioning Issues Log will include recommended responsible party and recommendations for resolution of the issue. The Commissioning Issues Log will also be used to document progress toward resolution and the final resolution	Commissioning Issues Log
Construction	Review Change Orders, ASI, and RFI	Review change orders, architect's supplemental instructions and requests for information (with design team response) for issues that affect commissioning. Review is for information only and does not constitute technical or contractual approval or disapproval.	Commissioning Review Log.

B. Design Phase Commissioning Services will be provided by Triple C – The A&E Group.

C. Construction Phase Commissioning Services will be provided at the Construction Site in Minneapolis, MN.

VI. Systems to Be Commissioned

A. The systems and equipment to be commissioned are outlined in the table below. A more detailed list of specific systems and equipment is provided in Appendix A.

Systems To Be Commissioned	
Fire Suppression	
Fire Suppression Systems	Wet pipe system, dry pipe system, pre-action system, special agent systems
HVAC	
Noise and Vibration Control	Noise and vibration levels for critical equipment such as Air Handlers, Chillers, Cooling Towers, Boilers, Generators, etc. will be commissioned as part of the system commissioning
Direct Digital Control System**	Operator Interface Computer, Operator Workstation (including graphics, point mapping, trends, alarms), Network Communications Modules and Wiring, Integration Panels. [DDC Control panels will be commissioned with the systems controlled by the panel]
Chilled Water System**	Chillers (centrifugal, rotary screw, air-cooled), pumps (primary, secondary, variable primary), VFDs associated with chilled water system components, DDC Control Panels (including integration with Building Control System)
HVAC Air Handling Systems**	Air handling Units, packaged rooftop AHU, Outdoor Air conditioning units, humidifiers, DDC control panels
HVAC Ventilation/Exhaust Systems	General exhaust, toilet exhaust, laboratory exhaust, isolation exhaust, room pressurization control systems
HVAC Terminal Unit Systems**	VAV Terminal Units, CAV terminal units, fan coil units, fin-tube radiation, unit heaters
Decentralized Unitary HVAC Systems*	Split-system HVAC systems, controls, interface with facility DDC, CRAC Units
Humidity Control Systems	Humidifiers, de-humidifiers, controls, interface with facility DDC

Systems To Be Commissioned	
Electrical	
Grounding & Bonding Systems	Witness 3rd party testing, review reports
Electric Power Monitoring Systems	Metering, sub-metering, power monitoring systems, PLC control systems
Electrical System Protective Device Study	Review reports, verify field settings consistent with Study
Low-Voltage Distribution System	Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc.)
Lighting & Lighting Control** Systems	Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
Communications	
Grounding & Bonding System	Witness 3rd party testing, review reports
Structured Cabling System	Witness 3rd party testing, review reports
Electronic Safety and Security	
Grounding & Bonding	Witness 3rd party testing, review reports
Physical Access Control Systems	Witness 3rd party testing, review reports
Video Surveillance System	Witness 3rd party testing, review reports
Fire Detection and Alarm System	100% device acceptance testing, battery draw-down test, verify system monitoring, verify interface with other systems.
Table Notes	
** Denotes systems that LEED requires to be commissioned to comply with the LEED Fundamental Commissioning pre-requisite.	

VII. Commissioning Team

A. The Commissioning Team shall consist of representatives from the following parties involved in the design and construction of this facility. The time at which individual members join the team and the level of their participation during the different phases of the project will vary from member to member.

Commissioning Team			
Item	**Team Member**	**Description**	**Contact Information**
PM	VAMC- Project Manager	Program Management Representative responsible for contractual and technical aspects of the project.	Name: TBD Organization Address City, State Zip Phone: Email:
COR	VAMC-Contracting Officer's Representative	On-site technical representative of the Contracting Officer.	Name: TBD Organization Address City, State Zip Phone: Email:
FMD	VAMC-Facilities Management Department	Representative of the Facilities Management Department	Name: TBD Organization Address City, State Zip Phone: Email:
A	Architectural Design Professional	Architect's Construction Administration Representative	Name: Mat Perkins Organization: Triple C the A&E Group Address: City, State Zip: Phone: 520.481.8548 Email: mat.perkins@triplecaeg.com

Commissioning Team			
Item	**Team Member**	**Description**	**Contact Information**
MEP	Mechanical, Electrical and Plumbing Design Professional	MEP Construction Administration Representative	Name: Kevin Luke Organization: Triple C – The A&E Group Address: City, State Zip: Phone: 307.399.7639 Email: kevin.luke@triplecaeg.com
CxA	Commissioning Agent	Project Manager for Commissioning Agent	Name: TBD Organization Address City, State Zip Phone: Email:
CPM	Construction Project Manager	Contractor's Project Manager responsible for construction and coordination of sub-contractors	Name: TBD Organization Address City, State Zip Phone: Email:
FP	Fire Protection Contractor	Commissioning Representative for the Sub-contractor responsible for installation of fire protection systems	Name: TBD Organization Address City, State Zip Phone:

			Email:

Commissioning Team			
Item	**Team Member**	**Description**	**Contact Information**
PLMG	Plumbing Contractor	Commissioning Representative for the Sub-contractor responsible for installation of plumbing systems	Name: TBD Organization Address City, State Zip Phone: Email:
HVAC	Mechanical Contractor	Commissioning Representative for the Sub-contractor responsible for installation of HVAC systems	Name: TBD Organization Address City, State Zip Phone: Email:
EC	Electrical Contractor	Commissioning Representative for the Sub-contractor responsible for installation of MV and LV electrical systems	Name: TBD Organization Address City, State Zip Phone: Email:
DDC	DDC Vendor	Commissioning Representative for the DDC vendor responsible for providing the control system(s)	Name: TBD Organization Address City, State Zip Phone: Email:
TAB	Testing and Balancing Vendor	Commissioning Representative for the TAB vendor responsible for certified air- and water-testing and balancing.	Name: TBD Organization Address City, State Zip Phone:

			Email:

B. Roles and Responsibilities for the Commissioning Team members are described elsewhere in this Commissioning Plan.

VIII. Commissioning Communications and Document Distribution

A. The following table outlines the submittal and distribution requirements for various documents used in the commissioning process.

Communication Distribution Matrix				
Document	**Prepared by:**	**Submitted to:**	**Copies to:**	**Comments**
Owner's Project Requirements	PM	• Design Team	• QA • CxA • CPM	
Schematic Design Documents	Design Team	• PM	• QA • CxA • CPM	Design team submits direct to VAMC
Design Development documents	Design Team	• PM	• QA • CxA • CPM	Design team submits direct to VAMC Building Department as separate submission
General Commissioning Requirements Specification Section (01 91 00)	CxA	• PM	• QA • Design Team	
Preliminary Commissioning Plan	CxA	• PM	• QA • CPM • Design Team • DDC • TAB	
Progress CD Drawings and Specs	Design Team	• PM	• QA • CxA • DDC	
Final Construction Documents	Design Team	• PM	• QA • CxA • CPM	Design team submits direct to VAMC as separate submission

Communication Distribution Matrix				
Document	**Prepared by:**	**Submitted to:**	**Copies to:**	**Comments**
Final Commissioning Plan	CxA	• COR	• QA • Design Team • CPM • DDC • TAB	
Submittals and Shop Drawings	CPM	• COR	• Design Team • CxA • QA	Submittals and Shop Drawings are submitted to the Design Team as separate submission
Submittal and Shop Drawing Comment Log	CxA	• COR	• CPM • Design Team • QA	Design team comments and/or approval provided separately to CPM and PM
Preliminary Pre-Functional Checklists	CxA	• COR	• QA • CPM • DDC	
System Pre-Functional Checklist Comments	CPM PM DDC	• COR	• CxA • QA	
Final Pre-Functional Checklists	CxA	• COR	• CPM • QA	
Executed Pre-Functional Checklists	CPM	• COR	• CxA • QA	
Contractor Startup Reports	CPM	• COR	• CxA • QA • Design Team • DDC	

Contractor Startup Report Comment Log	CxA	• COR	• QA • CPM • Design Team • DDC	

Communication Distribution Matrix				
Document	**Prepared by:**	**Submitted to:**	**Copies to:**	**Comments**
Preliminary Functional Test Procedures	CxA	• COR	• QA • CPM • DDC	
Preliminary Functional Test Procedure Comments	PM CPM DDC	• COR	• CxA • QA • DDC	
Final Functional Test Procedures	CxA	• COR	• QA • CPM • DDC	
Executed Functional Test Procedures	CxA	• COR	• QA • CPM • DDC	
TAB Final Report	TAB	• COR	• QA • Design Team • CxA	
TAB Final Report Comment Log	CxA	• COR	• QA • TAB • Design Team	
O&M Manuals	CPM	• COR	• QA • FMD • Design Team	
System Functional Testing Field Reports	CxA	• COR	• QA • CPM • DDC	
Preliminary Commissioning Report	CxA	• QA	• PM • CPM • DDC • TAB	

Communication Distribution Matrix				
Document	**Prepared by:**	**Submitted to:**	**Copies to:**	**Comments**
Commissioning Report Review Comments	QA	• CxA	• PM • CPM • DDC • TAB	
Final Commissioning Report	CxA	• QA	• PM • CPM • DDC • TAB	
Master Issues Log	CxA	• COR	• QA • CPM • DDC	
Commissioning Report Amendment	CxA	• QA	• PM	

IX. Pre-Design Phase Commissioning

A. Design Intent Document: During the Pre-Design Phase, VAPM will solicit and award contracts for the Design Team, Construction Manager and Commissioning Authority. Once these contracts are executed, the Design Team will begin developing the project design. The CPM will assist the Design Team by providing advice on construction issues and periodic cost estimates. The Design Team will prepare a Design Narrative to document the VA project requirements. The mechanical, electrical, plumbing, controls and other technical sections will provide a reference for all design and commissioning requirements. This document will be updated as needed during the design process to document changes in the VA project requirements.

B. Design Narrative: The Design Team will also prepare a Design Narrative that provides documentation on the design assumptions, design parameters, design calculations, and decisions made during design to implement the Design Intent Document. The Design Narrative is also submitted to the VAPM for review.

X. Design Phase Commissioning

A. Schematic Design Phase: The goals of the commissioning tasks in the Schematic Design Phase of the project include the following:

1. The CxA shall review the Schematic Design Documents to support the commissioning process. The review will be for the purpose of developing the Commissioning plan.

B. Design Development Phase: The goals of the commissioning tasks in the Design Development Phase of the project include the following:

1. The CxA shall review the Design Development Documents to support the commissioning process. The review will be for the purpose of developing the Commissioning plan.
2. The CxA will prepare the Preliminary Commissioning Plan to provide an initial framework for commissioning activities that will follow. This Preliminary Commissioning Plan will be aligned with the project scope and schedule. It will be reviewed by the PM, FMD, CPM and other interested parties.
3. The CxA will also prepare preliminary commissioning specifications to be included in the project manual. The preliminary specifications will include Section 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS as well as language to be included in other specification sections. The Design Team will review the preliminary commissioning specifications and provide written comments to the CxA. The CxA will revise the Preliminary Commissioning Specification and re-submit it to the Design Team.
4. The CxA will update the Commissioning Plan to incorporate any changes resulting from the Design Development submission and review comments.
5. The Design Narrative will be updated to incorporate decisions approved during the Design Development phase.

C. Construction Document Phase: The goals of the commissioning tasks in the Construction Document Phase of the project include the following:

1. The CxA will review the progress set and the Final Construction documents to support the commissioning process. Review will be for the purpose of developing appropriate Pre-Functional Checklists and Functional Test Plans.
2. The CxA will prepare a final, detailed list of systems and equipment to be commissioned.

3. The CxA will prepare preliminary Pre-Functional Checklists and Systems Functional Performance Test procedures for each type of system to be commissioned. These will

be published in the Preliminary Commissioning Plan to be included as an informational appendix to Specification Section 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS that will be issued for bid.

4. The Design Team will issue final Construction Documents, including drawings, and specifications. These will be reviewed by the CxA, PM, VAMC User, and FMD. The focus of the CxA review will be to support the commissioning process. Review will be for the purpose of developing appropriate Pre-Functional Checklists and Functional Test Plans. The CPM will also review the final construction documents and prepare the final estimates of construction costs.

XI. Construction and Acceptance Phase Commissioning

A. The CxA will prepare the Construction Commissioning Plan that incorporates any changes due to the Final Construction Documents, Design Narrative. This Commissioning Plan outlines the commissioning activities during the Construction and Acceptance Phase of the project.

B. The CxA will provide preliminary Commissioning Milestones, predecessors, successors, and durations to the CPM. The CPM will be able to use this data to integrate commissioning activities into the project construction schedule. The CxA will align commissioning activities with the construction schedule for each construction phase.

C. The CxA will review selected submittals and shop drawings relative to the systems to be commissioned. The review will be to determine if sufficient information is provided to describe system installation, operation and the information necessary to commission the equipment and systems.

D. The Commissioning Agent will prepare Pre-Functional Checklists that the installing sub-contractors will complete to document equipment and systems are complete and ready for testing.

E. The Commissioning Agent will also prepare detailed System Functional Performance Test plans that will provide detailed step-by-step procedures that will be used to verify system operations under all operating conditions. These test procedures will be issued to the RE, CPM, installing Contractors, DDC, TAB and FMD for review and comment. The reviews should focus on the ability to implement the steps, especially the control systems adjustments, necessary to perform the test. The reviewers should also note any procedures that would damage the equipment or system.

F. The installing sub-contractors are encouraged to use the System Functional Test Plans as a tool for pre-testing the equipment and systems prior to the “official” functional testing. This will allow early detection and resolution of problems.

G. It is the expectation that System Functional Testing will demonstrate that the systems perform in accordance with design criteria, construction documents and VA requirements. Functional testing pre-requisites are that the system components and equipment are completely installed, all required power connections are complete, all required control connections and control functions are operational, and that required air and hydronic testing and balancing has been completed. When required by construction specifications, third-party testing must also be complete and required test reports have been submitted to the COR and CxA for review.

H. Functional testing of each system to be commissioned will be conducted by the CxA. The CxA will witness and document the testing; the installing sub-contractors, DDC contractor, and TAB contractor will conduct the testing by operating the equipment, adjusting the control system and performing measurements in accordance with the System Functional Test Plan. The FMD staff is encouraged to assist in the testing as an additional training opportunity.

I. Issues and/or failures detected during the Functional Performance Testing will be documented on the test plan, on Field Observation reports and on the Master Issues Log. Installing sub-contractors, DDC contractor, and/or TAB contractor will be responsible for correcting each issue as directed by the COR and reporting the corrective action to the COR and CxA. The CxA will document the corrective action on the Master Issues Log. The need for re-testing will be determined by the COR in consultation with the CxA.

J. Upon completion of all commissioning activities, including resolution of all issues on the Commissioning Master Issues Log, the CxA will prepare and issue the Final Commissioning Report. This report will include the final version of the Commissioning Plan, Pre-Functional Checklists, Functional Performance Test results, and the Commissioning Master Issues Log.

XII. Team Member Roles and Responsibilities

A. The following is an outline of team member responsibilities in the Design phase and the Construction and Acceptance phase of the commissioning process. These responsibilities are meant to be limited to those tasks related to the commissioning process and are not intended to be representative of each team member’s contractual responsibilities for other aspects of this project.

B. In the table that follows, the tasks identified for the “CxA” include the Commissioning Project Manager, Commissioning Technical Lead, or other Commissioning Specialists and sub-consultants as directed by the CxA.

C. In the table that follows, the tasks identified for the “Design Team” include the Architect, MEP Engineer, Civil Engineer or other design consultants as directed by the COR and Architect.

D. In the table that follows, the tasks identified for “Contractor” include the Construction Project Manager, as well as the commissioning representatives for the installing sub-contractors, as directed by the COR and the Construction Project Manager.

E. In the table that follows, the tasks identified for “DDC” include the owner’s DDC Vendor as directed by the COR and CPM.

F. In the table that follows, the tasks identified for “TAB” include the owner’s TAB Vendor as directed by the COR or CPM.

Commissioning Team Roles and Responsibilities

Project Phase	Cx Task	Description	Team Member	Responsibility
Design	Review Owner’s Project Requirements	Review VAMC Design Criteria and Owner’s Project Requirement document.	VA PM	● Prepare and issue Owner’s Project Requirements based on specific requirements, Ed Specs and District Design Criteria.
			CxA	● Review Owner’s Project Requirements.
			Design Team	● Review for understanding project requirements.
			CPM	● None.

			DDC	• None

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			TAB	• None
Design	Review Design Narrative	Review the Design Narrative Document	VA PM	• Receive and distribute Basis of Design documents to CPM, CxA, and other VAMC agencies as necessary.
			CxA	• Review Design Narrative document.
			Design Team	• Prepare Phase 1 (Schematic Design) and Design Narrative to describe design approach.
			CPM	• None.
			DDC	• None
			TAB	• None
Design	Review Schematic design	Review Schematic Design for familiarization, general conformance with Owner's Project Requirements, Basis of Design and VAMC Design Criteria.	VA PM	• Receive and distribute Schematic Design package to Peer Reviewer, CxA, and other VAMC agencies as necessary.
			CxA	• Review Schematic Design

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			Design Team	• Prepare Schematic Design. • Incorporate changes into design as directed by PM.
			CPM	• None.
			DDC	• None
			TAB	• None
Design	Design Development design	Review Design Development design for familiarization, general conformance with Owner's Project Requirements, Design Narrative, and VA Design Criteria.	VA PM	• Receive and distribute Design Development package to Peer Reviewer, CxA, DDC and other VAMC agencies as necessary.
			CxA	• Review Design Development drawings and specs.
			Design Team	• Prepare Design Development drawings and specs. • Incorporate changes into design as directed by PM. • Update Design Narrative.
			CPM	• None.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			DDC	• None.
			TAB	• None
Design	Commissioning Specifications	Prepare Commissioning Specification "Section 01 91 00 – General Commissioning Requirements" to be included in project manual. Prepare Commissioning Specifications to provide detailed commissioning, operations & maintenance and training requirements for individual technical specification sections.	VA PM	• Review, comment and approve Cx specifications as part of project manual review.
			CxA	• Prepare Cx Specification Section 01 91 00. • Prepare systems commissioning specifications.
			Design Team	• Incorporate commissioning specifications into Project Manual.
			CPM	• None.
			DDC	• None.
			TAB	• None.
Design	Design Phase Controls Meeting	Meet with Owner, Architect, and Mechanical/Electrical	VA PM	• Schedule, facilitate and attend meeting.

		Design Engineer to review Building Control Systems and Sequences of	CxA	• None.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		Operations. The focus of the meeting will be to obtain understanding of the interactions between systems and the control system in various operating modes.	Design Team	• Attend meeting to discuss control sequences and strategies.
			CPM	• None
			DDC	• None.
			TAB	• None
Design	Preliminary Commissioning Plan	Prepare Preliminary Commissioning Plan that describes the Commissioning Process, Commissioning Team with specific Roles and Responsibilities. The Commissioning Plan will include description of systems to be commissioned.	VA PM	• Review Cx Plan • Provide comments to CxA.
			CxA	• Prepare Cx Plan • Submit to PM and QA
			Design Team	• Review Cx Plan relative to Design Team roles and responsibilities.
			CPM	• None.
			DDC	• None.
			TAB	• None.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
Design	Focused Construction Document Review (Progress Set)	Perform a focused review of a Construction Document progress submission (recommend review prior to the 50% CD stage).	VAMC PM	• Receive and distribute Progress Set drawings and specs to QA, CxA, DDC and other VAMC agencies as necessary.
			CxA	• Review Progress Set drawings and specs.
			Design Team	• Prepare Progress Set drawings and specs. • Incorporate changes into design as directed by PM.
			CPM	• None
			DDC	• None.
			TAB	• None
Design	Focused Construction Document Review	Perform a focused review of the final Construction Document submission. This review will include a back check of commissioning comments provided during previous reviews.	VA PM	• Receive and distribute Construction Documents package to QA, CxA, DDC and other VAMC agencies as necessary.
			CxA	• Review Construction Document drawings and specs.

			Design Team	• Prepare Construction Documents drawings and specs.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			CPM	• None.
			DDC	• None
			TAB	• None.
Design	Design Phase Meetings	Participate Design Phase meetings.	VA PM	• Schedule, facilitate and attend meetings
			CxA	• None.
			Design Team	• Conduct meetings. • Provide meeting minutes to PM, CxA and others as directed by PM.
			CPM	• None
			DDC	• None.
			TAB	• None.
Design	Focused Design Review Meetings	Attend Design Review meetings with to review the designs.	VA PM	• Schedule, facilitate and attend meetings.
			CxA	• None.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			Design Team	• Attend meetings to discuss design and to respond to commissioning and DDC comments.
			CPM	• None.
			DDC	• None.
			TAB	• None.
Construction	Final Commissioning Plan	Based on the final construction documents, update the Preliminary Commissioning Plan to identify specific systems to be commissioned. The Final Commissioning Plan will also include specific individual roles and responsibilities and preliminary Pre-Functional Checklists and Functional Test Plans for systems to be commissioned.	VAMC PM	• Review and approve Commissioning Plan. • Provide comments to CxA and QA.
			CxA	• Prepare Final Commissioning Plan. • Prepare preliminary Pre-Functional Checklists • Prepare Preliminary Systems Functional Performance Test procedures. • Issue to PM and QA. • Incorporate comments into Cx Plan revisions as necessary.

			Design Team	• Review Cx Plan relative to Design Team roles and responsibilities. • Provide comments to PM and CxA.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			CPM	• Review Cx Plan relative to CPM and installing sub-contractor's roles and responsibilities. • Provide comments to PM and CxA.
			DDC	• Review Cx Plan relative to DDC roles and responsibilities. • Provide comments to QA and CxA.
			TAB	• Review Cx Plan relative to TAB roles and responsibilities. • Provide comments to QA and CxA.
Construction	Duration Schedule for Commissioning Activities	Based on Final Commissioning Plan, prepare a duration schedule to show the duration, predecessors and successors for commissioning activities. This duration schedule will be provided to the Construction Manager to include commissioning activities in the project construction schedule. This will allow commissioning activities to be smoothly integrated	COR	• Review commissioning schedule data. • Coordinate with CPM to incorporate commissioning activities into project schedule.
			CxA	• Prepare and issue commissioning activities schedule, including durations and predecessors. • Review project schedule prepared by CPM.
			Design Team	• None.

		into the overall construction process.	CPM	• Incorporate commissioning activities into Master Construction Schedule.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			DDC	• Review project schedule prepared by CPM.
			TAB	• Review project schedule prepared by CPM.
Construction	Submittal and Shop Drawing Review	Review selected submittals and shop drawings to support the commissioning process. The review will be for the purpose of developing appropriate Pre-Functional Checklists and Functional Test Plans. Reviews will focus on the ability to commission the systems, maintainability and general conformance to owner's requirements. Commissioning review of submittals and shop drawings does not replace the Design Team responsibility for approval.	COR	• Receive and distribute submittals and shop drawings. • Distribute selected submittals and shop drawings to CxA. • Review and approve submittals
			CxA	• Review selected submittals and shop drawings. • Prepare issue comment log
			Design Team	• Review submittals and shop drawings. • Provide comments and recommendations to VA COR.
			CPM	• Prepare and issue submittals and shop drawings. • Incorporate RE comments into revised submittals and shop drawings.

			DDC	• Prepare and issue DDC submittals and shop drawings. • Incorporate RE comments into revised submittals and shop drawings.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			TAB	• None.
Construction	Controls Meeting	After receipt of the Controls Submittal, participate in or conduct a meeting with the Owner's representatives, Owner's Control Vendor, Owner's TAB contractor, Mechanical/Electrical Design team, mechanical sub-contractor and electrical sub-contractor to review the Controls Submittal and mechanical/electrical systems to be installed. Focus will be on how the selected sequences of operation interact with the mechanical/electrical systems and how well they meet the owner's requirements.	COR	• Schedule, facilitate and attend meeting.
			CxA	• None.
			Design Team	• Attend meeting
			CPM	• Coordinate and schedule Mechanical, Electrical and Controls Electrical sub-contractors to attend meeting. • Attend meeting.
			DDC	• Attend meeting
			TAB	• None.
Construction	Pre-Functional Checklists	Prepare Pre-Functional Checklists for systems,	COR	• Review checklists. • Provide comments to CxA

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		components and/or equipment to be commissioned. These Pre-Functional Checklists will be used to document completion of system, component and/or equipment installation and to determine system readiness for functional testing. Pre-Functional Checklists should be completed by the installing contractors to document the installation process. Completed Pre-Functional Checklists are to be submitted to the commissioning authority a minimum of seven days prior to testing. Completed Pre-Functional Checklists will be spot checked by the commissioning authority to verify systems are ready for testing.	CxA	• Prepare preliminary checklists. • Issue to RE and CPM for review. • Incorporate changes into final checklists as necessary.
			Design Team	• None.
			CPM	• Provide copies of sub-contractor QC installation checklists to CxA for review. • Review checklists prepared by CxA. • Provide comments to CxA
			DDC	• Review checklists prepared by CxA. • Provide comments to CxA
			TAB	• Review checklists prepared by CxA. • Provide comments to CxA
Construction	Review Contractor Equipment Startup Reports	Commissioning authority will review selected equipment startup reports prepared by installing contractor.	COR	• Receive and distribute Contractor Startup Reports
			CxA	• Review selected Startup Reports.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		Commissioning Agent will witness selected equipment startup procedures. Seven days prior notice is required to schedule commission authority witnessing the startup.	Design Team	• Review Contractor Startup Reports.
			CPM	• Complete Contractor Startup Reports • Issue to RE and CxA.
			DDC	• Review selected Contractor Startup Reports.
			TAB	• Review selected Contractor Startup Reports.
Construction	Prepare Functional Test Procedures	Based on final construction documents (including applicable changes), and approved submittals, prepare Functional Test Procedures for systems to be commissioned. Draft Functional Test Procedures will be issued for review by the owner, installing contractors and DDC Vendor. Final Functional Test	COR	• Review preliminary Functional Test Procedures. • Provide comments to CxA
			CxA	• Prepare preliminary Functional Test Procedures. • Issue to RE, CPM and DDC. • Incorporate comments into final Functional Test Procedures as necessary.
			Design Team	• None.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		Procedures will be prepared incorporating review comments received from owner, contractors or DDC Vendor.	CPM	• Distribute preliminary Functional Test Procedures to MC, EC and other installing sub-contractors. • Review preliminary Functional Test Procedures • Provide comments to CxA
			DDC	• Review preliminary Functional Test Procedures • Provide comments to CxA
			TAB	• Review preliminary Functional Test Procedures • Provide comments to CxA
Construction	TAB Report Review	Review TAB Report prepared by TAB vendor following system air and water balancing. Review will be focused on TAB results that affect system performance and/or commissioning. Specific attention will be given to equipment installation and operational issues identified by the TAB vendor.	COR	• Distribute TAB report to Design Team, and CxA. • Approve TAB Report in consultation with Design Team and CxA.
			CxA	• Review TAB report. • Provide comments to RE and Design Team.
			Design Team	• Review and provide recommendations to RE.
			CPM	• Review and submit TAB Report.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			DDC	• None
			TAB	• Provide preliminary TAB data (daily worksheets) to CxA for preliminary review. • Prepare TAB Report • Issue TAB report to RE.
Construction	Review O & M Manuals	Review Operations and Maintenance Manuals submitted by contractors. Manuals will be reviewed for clarity, organization, usability and general conformance with specifications and owner's requirements.	COR	• Distribute O&M Manuals to CxA and Design Team. • Review and approve O&M Manuals.
			CxA	• None.
			Design Team	• Review O&M Manuals.
			CPM	• Prepare and issue O&M Manuals to PM.
			DDC	• Prepare and issue DDC O&M Manuals to PM.
			TAB	• None.

Construction	Systems Functional Testing	Witness and document functional testing for systems to be commissioned. Testing will be conducted as detailed on the specific	COR	• Schedule, facilitate and witness systems functional testing. • FMD staff should assist in functional testing as additional systems training opportunity.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		Functional Test Plan for each system to be commissioned. Functional testing will require support from the CPM, MC, EC, DDC and TAB Vendor. Installing contractors should be available to respond to issues and problems identified during testing.	CxA	• Witness systems functional testing using previously prepared Functional Test Procedures. • Document systems testing on Functional Test Procedures. • Issue Field Reports to document deficiencies. • Update Master Commissioning Issues Log to document and track deficiencies.
			Design Team	• Review test documentation
			CPM	• CPM, MC and EC to conduct functional testing by operating systems in accordance with functional test procedures. • Make corrections, repairs or adjustments to systems during testing as directed by the RE. • Correct outstanding deficiencies after testing as directed by the RE. • Report corrective actions to RE and CxA upon completion.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			DDC	• Conduct functional testing by operating DDC in accordance with CxA directions and functional test procedures. • Assist in troubleshooting and corrective action as necessary
			TAB	• Assist functional testing as directed by the RE and functional test procedures. • Verify selected DDC data by spot measurements of air and/or water balancing data.
Construction	Systems Functional Retesting	Retest systems with deficiencies as recommended by the CxA and directed by the PM. (Note: Retesting is not included in the scope of commissioning services and is provided as an additional service. The costs associated with retesting may be	COR	• Approve retesting as recommended by CxA. • Schedule and coordinate retesting.
			CxA	• Make recommendations for necessary retesting. • Coordinate with RE to schedule retesting after deficiencies are corrected.
			Design Team	• None

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		recovered from the Construction Manager in accordance with appropriate contract provisions.)	CPM	• Make necessary system repairs, adjustments and/or corrections prior to retesting. • Coordinate retesting as directed and approved by the RE. • Conduct systems retesting by operating systems as directed by RE and functional test procedures.
			DDC	• Assist in systems retesting by operating DDC as directed by RE and functional test procedures.
			TAB	• None.
Construction	Final Commissioning Report	Compile a comprehensive commissioning report documenting all commissioning activities, including but not limited to: • Commissioning scope • Test methods and results. • Outstanding commissioning issues	COR	• Review preliminary Commissioning Report. • Provide comments to CxA. • Review and approve Final Commissioning Report
			CxA	• Prepare preliminary Commissioning Report. • Incorporate VA comments into final report. • Issue Final Commissioning Report.

		• Issues log • Commissioning plan	Design Team	• Review Final Commissioning Report

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		• Status reports • Submittal and O&M manual reviews • Training record • Pre-Functional Checklists • Design Review Comments .	CPM	• Review Final Commissioning report. • Report on progress and completion of corrective actions.
			DDC	• Review Final Commissioning Report. • Report on progress and completion of corrective actions relative to DDC.
			TAB	• Review Final Commissioning Report. • Report on progress and completion of corrective actions relative to TAB.
Construction	Owner Architect and Construction Manager Meetings (Construction Phase)	Attend selected Owner/Architect/Contractor Meetings to discuss commissioning issues, review the Commissioning Issues Log, and to maintain awareness of general construction schedule and issues.	COR	• Schedule, facilitate and attend meetings.
			CxA	• None.
			Design Team	• Attend meetings.
			CPM	• Conduct meetings. • Prepare and issue Meeting Minutes.
			DDC	• Attend selected meetings to review DDC issues.
			TAB	• Attend selected meetings to review TAB issues.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
Construction	Master Issues Log	Maintain a Commissioning Issues Log to document commissioning issues identified during construction and functional testing. The Commissioning Issues Log will include recommended responsible party and recommendations for resolution of the issue. The Commissioning Issues Log will also be used to document progress toward resolution and the final resolution	COR	• Review Master Issues Log • Coordinate and direct corrective actions to resolve commissioning issues.
			CxA	• Provide monthly updates to Master Commissioning Log. • Provide updated Master Commissioning Log after each Construction Visit to document specific issues observed during the visit. • Update Master Issues Log to document progress on corrective actions. • Update Master Issues Log to document completion of corrective actions.
			Design Team	• None.
			CPM	• Review Master Issues Log. • Provide status of corrective actions. • Provide notification of corrective action completion.

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
			DDC	• Review Master Issues Log. • Provide documentation of punch list or other issues noted by DDC vendor. • Provide status of corrective actions relative to DDC issues. • Provide notification of corrective action completion relative to DDC issues.
			TAB	• Review Master Issues Log. • Provide documentation of punch list or other issues noted by TAB vendor. • Provide status of corrective actions relative to TAB issues. • Provide notification of corrective action completion relative to TAB issues.
Construction	Review Change Orders, ASI, and RFI	Review change orders, architect's supplemental instructions and requests for	COR	• Issue change orders, ASI and/or RFI. • Provide copies of change orders, ASI and RFI to CxA

Commissioning Team Roles and Responsibilities				
Project Phase	**Cx Task**	**Description**	**Team Member**	**Responsibility**
		information (with design team response) for issues that affect commissioning. Review is for information only and does not constitute technical or contractual approval or disapproval.	CxA	• Review change orders, ASI, and RFI for changes that affect system/equipment design or installation. • Incorporate changes into revised Functional Test Procedures or Pre-Functional Checklists.
			Design Team	• Respond to RFIs. • Prepare change orders and/or ASI. • Update construction documents as necessary.
			CPM	• Issue RFI. • Request change orders and ASI as needed.
			DDC	• Monitor system changes for impact on DDC installation and/or sequences of operations. • Update DDC programming or sequences of operations to implement approved changes.
			TAB	• Monitor system changes for impact on TAB. • Update TAB Plan as necessary to implement approved changes.

XIII. Commissioning Schedule

A. The following is a general outline of the Commissioning Schedule for the commissioning tasks that will be performed on the project site or at the Commissioning Agent Offices:

Commissioning Schedule				
Project Phase	**Task**	**Duration**	**Schedule**	**Predecessors**
Design	Review Owner's Project Requirements			Receive Owner's Project Requirement document
Design	Review Design Narrative			Receive Design Narrative
Design	Commissioning Specifications	TBD	Specifications issued	Receive DD-1 drawings and specifications
Design	Review DD1			Receive DD-1 drawings and specifications
Design	Preliminary Commissioning Plan	TBD	Preliminary Cx Plan issued	Receive DD-1 drawings and specifications
Design	Review DD2	TBD		Receive DD-2 drawings and specifications
Design	Review Updated Design Narrative	TBD		Receive DD-2 drawings and specifications.
Design	Review CD1	TBD		Receive CD-1 drawings and specifications
Design	Review Updated Design Narrative	TBD		Receive CD-1 drawings and specifications.
Design	Review CD2	TBD		Receive CD-2 drawings and specifications

Design	Review Updated Design Narrative	TBD		Receive CD-2 drawings and specifications.

Commissioning Schedule				
Project Phase	**Task**	**Duration**	**Schedule**	**Predecessors**
Construction	Preliminary Commissioning Plan	TBD	Concurrent with Final CD Design review	Receive CD-2 drawings and specifications.
Construction	Duration Schedule for Commissioning Activities	TBD	Issued as part of Final Commissioning Plan	Preliminary construction schedule
Construction	Submittal and Shop Drawing Request List	TBD	Issued as part of Final Commissioning Plan	Final Construction Document plans and specifications
Construction	Submittal and Shop Drawing Review	TBD	Comment log issued after receipt of shop drawings and submittals	Receipt of submittal or shop drawings. Comment log will be updated after receipt of each requested submittal
Construction	Pre-Functional Checklists	TBD	Preliminary checklists issued approximately 4 months prior to substantial completion. Final checklists issued approximately 3 months prior to substantial completion	Receive equipment submittals. Receive installing contractor's QC checklists
Construction	Prepare Functional Test Procedures	TBD	Preliminary Functional Test Procedures issues approximately 4 months prior to substantial completion. Final Functional Test Procedures issues approximately 3 months prior to substantial completion	Receive all requested equipment submittals and shop drawings. Receive DDC submittal and final sequences of operations.

Construction	TAB Report Review	TBD	Comment log issued after receiving TAB Report	Receive TAB Report

Commissioning Schedule				
Project Phase	**Task**	**Duration**	**Schedule**	**Predecessors**
Construction	Systems Functional Testing	TBD	Functional testing to begin coordinated with construction schedule and systems completion	See separate table.
Construction	Systems Functional Retesting as Required	TBD	TBD	Corrective actions complete
Construction	Final Commissioning Report	TBD	Preliminary Commissioning Report issued after completing Functional Testing	Functional Testing completed.
Construction	Master Issues Log	TBD	Master Issues Log will be updated and issued following each Construction Observation visit, PFC review, FTP review, and Document review.	Construction Observation, PFC review, FTP review, Document Review.
Construction	Review Change Orders, ASI, and RFI	TBD	Ongoing throughout construction	Receive Change Order, ASI or RFI

B. The following is a general outline of the Commissioning Schedule for the Functional Testing activities that will be performed at the construction site. This information is provided to assist the General Contractor in incorporating the commissioning activities into the overall construction schedule. This FPT Template will be developed and completed prior to construction Phase Commissioning.

Functional Testing Activities (Template)				
System	**Test Duration**	**Schedule**	**Predecessors**	**Notes**

Refrigeration Piping	1 day	1-week prior notice by CPM	Equipment installation in-process	• Witness selected vacuum testing

Functional Testing Activities (Template)				
System	**Test Duration**	**Schedule**	**Predecessors**	**Notes**
Hydronic Pumps	4 hours per system	Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational • TAB water balance	• Functional testing of pump systems
Air-Cooled Refrigerant Condensers	2-4 hours per system	Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational	• Functional testing of a representative sample of condenser systems
Air-Cooled Chilled Water Systems	1 day per system	1-week prior notice of startup by CPM Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational • TAB water balance	• Witness equipment startup. • Functional testing of all chillers
Variable Frequency Motor Controls	Included in other testing	1-week prior notice of startup by CPM	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational •	• Witness selected equipment startup. • Functional testing in conjunction with testing the motor and system controlled

Functional Testing Activities (Template)				
System	**Test Duration**	**Schedule**	**Predecessors**	**Notes**
Air Handling Units	1 day per AHU	1-week prior notice of startup by CPM Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • DDC Controls Operational • TAB air & water balance	• Witness selected equipment startup. • Functional testing of all air-handling units
Ductwork	1 day	1-week prior notice by CPM	• Ductwork complete	• Witness selected duct pressure testing
DDC System	1 day for head-end testing	1-week prior notice of startup by CPM Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational • TAB air & water balance	• Review DDC sequences of operation. • Witness selected equipment startup. • Functional testing of DDC in conjunction with air handler units, chillers, and other systems controlled. • Review of DDC graphics and other human-interface equipment. • Review of trend data to support functional testing and verify proper operation of systems controlled
Variable Air Volume Units	1 – 2 hours per AHU system	Functional Testing TBD	• Pre-Functional Checklist • Equipment startup • Controls & DDC Interface Operational • TAB air balance	• Functional testing of a representative sampling

Tests HVAC Piping Systems	1 day	1-week prior notice by CPM	• Piping system complete	• Witness selected HVAC piping tests

XIV. Construction Phase Commissioning

A. The construction phase commissioning begins with the notice to proceed and concludes when all systems to be commissioned have been installed and accepted by the Owner. During the construction phase of the project delivery process, systems and assemblies are installed, inspected, tested, and placed into service to meet the Owners' Project Requirements. The Commissioning Agent will perform the following tasks during Construction Phase Commissioning.

B. PRELIMINARY CONSTRUCTION PHASE COMMISSIONING PLAN

1. The CxA shall prepare the Interim Construction Phase Commissioning Plan which identifies the commissioning and testing standards and outlines the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, documentation requirements for the construction phase of the project.

C. REVIEW APPROVED CONSTRUCTION SUBMITTALS

1. The CxA will review selected approved submittals related to systems being commissioned for general conformance with the Construction Documents. The CxA shall review and comment on the ability to test and operate the system, including providing gages, controls and other components required to operate, maintain, and test the system. The CxA shall review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents. When the Prime Contractor receives the approved submittal schedule from the A/E, the CxA will indicate on the submittal schedule which submittals are commissioning related.

2. The Prime Contractor shall notify the CxA of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems.

D. FINAL CONSTRUCTION PHASE COMMISSIONING PLAN

1. The CxA shall prepare the Final Construction Phase Commissioning Plan which will include Pre-Functional Checklists, Functional Performance Test Checklists and Integrated System Test Checklists if required for each system required to be commissioned. This report will also include the items from the Interim Construction Phase Commissioning Plan.

E. CONSTRUCTION PHASE COMMISSIONING COORDINATION MEETING (Cx KICK-OFF MEETING)

1. A commissioning scoping meeting shall be planned and conducted by the CxA. In attendance will be the respective representatives of the Owner, the A/E, the general Contractor and his mechanical, electrical, controls, and TAB subs. At the meeting, the commissioning parties will be introduced. The commissioning process will be reviewed, and management and reporting lines determined. The flow of documents, how much submittal data the CxA will receive will also be discussed. The Cx Plan will be reviewed, process questions will be addressed, lines of reporting and communications determined, and the work products list will

be discussed. The meeting will cover the general list of each party's responsibilities, who is responsible for developing the startup plan for each piece of equipment and the proposed commissioning schedule. The outcome of the meeting is increased understanding by all parties of the commissioning process and their respective responsibilities. The meeting provides the CxA additional information needed to finalize the Construction Cx Plan, including the commissioning schedule.

F. COMMISSIONING TEAM MEETINGS

1. The CxA will periodically attend the job progress meetings. The Prime Contractor will be given advance notice prior to a meeting date if the CxA requests to have an agenda item for that meeting. In addition to the regularly scheduled job progress meetings, the CxA may conduct separate commissioning progress meetings with an agenda focused solely on commissioning related issues. The frequency of these meetings is dependent on the progress of work and the quality of documentation being provided by the commissioning team members. If work is progressing on schedule and the documentation is complete and up to date, there will be fewer commissioning progress meetings required. The CxA will notify all expected attendees well in advance of scheduling a commissioning progress meeting. Throughout the construction phase of the Project, the CxA will communicate and/or meet periodically with the construction team as needed.

G. PRE-FUNCTIONAL CHECKLISTS (PFC)

1. The Technical Commissioning Specialist develops the Pre-functional Checklists (PFCs). These Checklists are important to ensure that the equipment and systems are installed and operational and that Functional Performance Testing (FPT) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout by the sub-contractors (discipline specific). No sampling strategies are used. In general, the PFC for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

2. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (fan belt tension, gages in place, sensor calibration, etc.). Some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). Pre-functional checklists augment and are combined with the manufacturer's start-up checklist.

3. Contractors typically already perform some, if not all, of the pre-functional checklist items the commissioning authority will recommend. Few contractors document in writing the execution of these checklist items. This project requires that the procedures be documented in writing by the installation technician. In general, the commissioning authority is interested in insuring that the correct personnel are present, the approved start-up forms are being used to document the process, and that any additional information required by the PFC forms is gathered as required.

H. STARTUP AND INITIAL CHECKOUT PLAN

1. The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
2. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
3. The full startup plan shall at a minimum consist of the following items:
    a. The Pre-Functional Checklists (provided by the CxA)
    b. The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end (provided by subcontractors)
    c. The manufacturer's normally used field checkout sheets (provided by subcontractors).

I. CONTROLS CHECKOUT DOCUMENTATION

1. The Controls Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the Contracting Officer’s Representative and Commissioning Agent.
    a. Point-to-Point checkout documentation.
    b. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
    c. A sensor calibration table referencing the location of procedures to follow in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation.
    d. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in an outline or table separated by system, control type (e.g., heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop.

J. TESTING, ADJUSTING AND BALANCING

1. The TAB contractor submits the TAB Plan prior to starting TAB work. Included in the plan is an explanation of the intended use of the BAS. The CxA reviews the plan and approach for understanding and coordination issues and may comment but does not approve. The Controls

Contractor reviews the feasibility of using the BAS for facilitating the TAB work. The GC, with input from the TAB contractor and the CxA, incorporates TAB activities into the Master Schedule.

2. The CxA shall review the TAB report and identify any issues to the COR and Prime Contractor. Once all TAB issues are resolved, the CxA will conduct TAB Verification.

K. DEVELOPMENT OF FUNCTIONAL PERFORMANCE TESTS (FPT)

1. Functional Performance Testing is the dynamic testing of systems under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outdoor air temperatures, fire alarm, power failure, etc. The systems are run through all the control systems sequences of operation and components are verified to be responding as the sequences state. The commissioning agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor.

L. SCOPE OF TESTING

1. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the functioning of the systems.

2. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. In the interim before commissioning a pre-functional checklist will be included. This will cover the items for physical inspection and the functional performance of the Integrated system test and will explain the step-by-step actions and expected results that will demonstrate that the system performs in accordance with the contract in the functional performance test and integrated systems test checklist.

M. FUNCTIONAL PERFORMANCE TEST CHECKLIST

1. The functional performance test checklist will also include the procedure that explains, step-by-step, the actions and expected results that will demonstrate that installation and start-up of equipment and system is complete. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

N. DEVELOPMENT PROCESS

1. Before test procedures are written, the CxA obtains all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, control sequences and set points.

2. The CxA develops specific test procedures to verify proper operation of each piece of equipment and system. The CxA obtains clarification, as needed, from contractors and the A/E regarding sequences and operation to develop these tests.

3. Prior to execution, the CxA provides a copy of the primary equipment tests to the installing Sub who reviews the tests for feasibility, safety, warranty and equipment protection. Blank copies of the procedures are input into the O&M manuals for later use by operations staff. Refer to Appendix A, Chart 2 for an illustration of the development of functional test forms and Chart 4 for the functional test submittal map.

4. Functional testing and verification will be achieved by manual testing (persons manipulate the equipment and observe performance). The CxA follows the Contract Drawings and uses judgment where needed to establish the testing procedures.

O. CONSTRUCTION PHASE DOCUMENTATION

1. Acceptance of construction phase commissioning requires the delivery of the following documentation at the conclusion of the construction phase:

   a. Interim Commissioning Plan (Completed by CxA)

   b. Final Commissioning Plan (Completed by CxA)

   c. Startup and Initial Checkout Plan (Provided by CxA and Subcontractors)

   d. Completed Pre-Functional Checklists (Completed by Subcontractors)

   e. Completed Start-up Reports (Completed by Subcontractors)

   f. Controls Checkout Documentation: Point to Point Checkout, Sensor Field Calibration, Loop Tuning (provided by Controls Contractor)

   g. Final TAB Report (Completed by TAB Contractor)

   h. Blank Functional Test Forms (Provided by CxA)

P. DDC SYSTEM TRENDING

1. The Controls Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending shall occur before, during and after Systems Functional Performance Testing. The Controls Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the Contracting Officer’s Representative and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Controls Contractor shall provide, at minimum, the following trend requirements, and trend submissions:

   a. Pre-testing, Testing, and Post-testing – Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time

during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the Contracting Officer's Representative. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the Contracting Officer's Representative, prior to the execution of Systems Functional Performance Testing.

b. Dynamic plotting – The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.

c. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System, then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.

Q. EXECUTION OF EQUIPMENT FUNCTIONAL PERFORMANCE TESTS

1. The CxA schedules functional tests through the Prime Contractor, and affected Subs. The CxA oversees witnesses and documents the functional testing of all equipment and systems according to the Specifications and the Cx Plan. The Subs execute the tests. The control system is tested before it is used to verify performance of other components or systems and the air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems and finally to interlocks and connections between systems.

2. PREREQUISITES: All equipment, components, and devices applicable to the test must be started and this start up must be documented. This includes completion of the Pre-Functional Checklists, pressure testing of equipment, duct, pipe, etc., flushing/cleaning of applicable systems, completed labeling and identification, completed insulation of applicable systems, completed TAB, etc. Functional testing is not to begin until all Verification tests, start-ups, and TAB have been completed for each given system. The building automation controls system and equipment it controls will not be functionally tested until all points have been calibrated and Verification testing has been completed. TAB is not performed until the controls system has been sufficiently pre-tested and approved by the MC for TAB work, except for preliminary system adjusting.

3. INSTRUMENTATION: Contractor of Division 21, 22, 23, 26, 27 and 28 shall provide test equipment necessary to fulfill the testing requirements.

4. TEST METHOD: Methods for functional testing and verification include

direct manipulation of system outputs, manipulation of system inputs with the automatic temperature control inputs (i.e., software override of sensor inputs), trend logs of system inputs and outputs using the temperature control devices to verify system performance under various modes including heating, cooling, and other mode of operation. Opposite season test conditions shall be simulated to verify the operation of the system, and it will be decided during the commissioning scoping meeting. The CxA determines which method, or combination of methods, is most appropriate. In general, the preferred test method is to adjust setpoints (outputs) rather than inputs.

5. PARTICIPATION: Participation of the appropriate sub-contractors is typically required. The extent of the participation is indicated in the test procedures presented below and in the Construction Specifications.

6. TEST DOCUMENTATION: CxA will witness tests as applicable and are conducted by contractor. CxA will record test results on the forms developed for the testing. CxA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly be indicated when the test is failed. When all related testing is completed successfully, CxA shall recommend acceptance of the system or component.

7. DEFICIENCIES AND RE-TESTING: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require failure of the test and re-testing. Deficiencies of this magnitude will result in an action item on the Issues Log. The CxA schedules the re-testing through the A/E. The resolution of the deficiency will then subsequently be tracked by the CxA via the Deficiency Logs. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between CxA or Prime Contractor and the Subcontractor. For areas in dispute, final authority, besides the Tenant’s, resides with the A/E. The CxA recommends acceptance of each test to the A/E. The A/E gives final approval on each test.

8. SEASONAL TESTING: The CxA shall schedule, coordinate, execute, and document additional testing for seasonal variation in operations and control strategies during the appropriate season to verify the performance of the HVAC system and control.

9. SAMPLING: Multiple identical pieces of non-life-safety or otherwise non-critical equipment are to be functionally tested for 100% of all systems. No Sample strategy is used in this project.

R. OPERATIONS AND MAINTENANCE MANUAL DOCUMENTATION

1. The commissioning process requires detailed recording O&M documentation. Record documentation shall mean O&M information which is sufficiently marked as to indicate exact model and options installed on this Project, as well as a record of as-built final set points, ranges, time delays, and settings. The responsible contractor shall engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system. For

systems being commissioned, the O&M manual shall comply with the requirements of this section:

a. The O&M manual shall include performance and design criteria, operating standards, operating procedures, operating logs, wiring diagrams, control diagrams, wiring diagrams, precautions against improper use. Proper designations must be used for systems and equipment indicated on Contract Documents.

b. For systems and equipment, document product name, model number, make and identify equipment with serial number for each component. Include a complete nomenclature and number of replacement parts. In addition, compile information such as operating characteristics, limiting conditions, performance curves and engineering data and tests.

c. Provide startup procedure, equipment's or system break-in procedure, routing and normal operating instructions, normal shutdown instructions, seasonal weekend, and operating instructions.

d. For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

e. Maintenance procedures must detail essential maintenance procedures: Test and Inspection Instruction, troubleshooting guide, precautions against improper maintenance, disassembly- component removal, repair, and replacement; and reassembly instructions, aligning, adjusting, and checking instructions.

S. OPERATING PERSONNEL TRAINING PROCEDURE

1. Adequate and thorough training of the operators and the facilities staff is vital to effective transition and early occupancy of the building. A key goal of the Cx Team is to ensure this is accomplished. Owner training and orientation on equipment and system provided by the contractor is defined in the project specification. The training will be scheduled by the Prime Contractor. This training schedule will identify all the equipment for which training, or orientation will be provided, the type, and number of trainees, rigor of training desired by the Owner, and the primarily responsible subcontractor.

2. PREREQUISITES: To accomplish more effective training, the contractor would be required to submit O&M Manuals before Functional Testing begins. This would allow the manuals to be used as a learning tool for systems operation and personnel to be trained in how to effectively use these manuals as a future resource.

3. O&M TRAINING SCOPE: The systems from the division 21, 22, 23, 26, 27 & 28 of specification shall be included in the training plan.

4. TRAINING PLAN: The Prime Contractor, with input from the subcontractors, shall develop an O&M training plan and submit it to the

CxA for review. The training plan shall summarize training sessions with topics to be covered and approximate duration. The training shall occur throughout the Construction Phase and into the Occupancy and Operations phase as appropriate to the construction schedule. Training shall cover all operating scenarios to help the building engineering team understand the most effective and efficient way to operate the building. A robust training program will address the following:

a. Demonstration of operation of systems, subsystems, and equipment.

b. Training in operation and maintenance of systems, subsystems, and equipment, including environmental considerations.

c. Demonstration and training video

5. TRAINING MODULE: Responsible contractors shall 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:

   a. Basis of System Design, Operational Requirements, and Criteria

   b. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.

   c. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.

   d. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.

   e. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments

   f. Troubleshooting: Include diagnostic instructions and test and inspection procedures.

   g. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.

   h. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

6. SCHEDULE: Minimum of 2-week period for Owner review and staff coordination is required prior to each training session and the providing contractor will provide a training agenda for their area of training responsibility. The agenda shall be provided to the CxA for approval prior to two weeks ahead of training instruction. When the training is complete,

the contractor provides a copy of the document to the CxA and Owner. The CxA will review the documentation and recommend final approval. The CxA at his discretion may witness any training sessions.

T. POST-OCCUPANCY EVALUATION

1. The post-occupancy activities begin 10 months after substantial completion depending on the phased turnover of the buildings and include any delayed or seasonal testing not yet completed. CA to coordinate with GC to schedule post-occupancy activities based on the phased turnover of the buildings. The CA will monitor the progress of the O&M staff's knowledge and operation of the installed systems and provide supplemental instructions to fill in the gaps. Also, any warranty issues should be addressed during this time. The Owner or Prime Contractor is responsible for contractor call-backs.

U. ACCEPTANCE PHASE DOCUMENTATION

1. Acceptance phase commissioning culminates with the completion of commissioning which includes functional testing and issues resolution, completion of O&M training, submission of O&M and commissioning forms. The final approval of the functional test forms, comp by the CxA. Documentation delivered at the conclusion of the construction phase includes:

   a. 3rd Party Test Reports (provided by Subcontractors)

   b. Pre-FPT DDC Trend Logs (provided by Controls Contractor)

   c. Completed Functional Performance Tests (provided by CxA)

   d. During and Post-FPT Trend Logs (provided by Controls Contractor)

   e. O&M Manuals (provided by Subcontractors)

   f. O&M Training Plan and Attendance Roster (provided by Prime Contractor)

XV. Log of Required Documentation

The following documents shall be provided to the CxA for review:

- Design Documents
- Design Narrative
- Design Specifications
- Submittals & Shop Drawings
- RFIs
- Change Orders
- Equipment Start Up sheets both template and complete.

- O&M Manual
- Test & Balance Plan
- Test & Balance Report

XVI. List of Appendices

A. Issues Log / Resolution Tracking Forms - TBD

B. Commissioning Review Log - TBD

C. Pre-Functional Checklist - TBD

D. Functional Performance Test - TBD

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies demolition and removal of portions of buildings, utilities, other structures and debris from trash dumps shown.

B. Any vibratory, loud or otherwise disruptive activity shall be completed after-hours (nights and weekends). No additional compensation for overtime/off-hours work will be authorized and pricing for this off-hours work shall be included in the base bid.

1.2 RELATED WORK:

A. Safety Requirements: Section 01 35 26 Safety Requirements Article, ACCIDENT PREVENTION PLAN (APP).

B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

E. Construction Waste Management: Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

F. Infectious Control: Section 01 35 26, SAFETY REQUIREMENTS.

1.3 PROTECTION:

A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.

C. The Medical Center maintains a zero-tolerance policy related to dust, debris, etc. in construction areas. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
   1. Any vibratory/loud/disruptive demolition activity will have to be completed after-hours (nights/weekends). No additional compensation for overtime/off-hours work will be authorized and pricing for this off-hours work shall be included in the base-bid.

D. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
   1. No wall or part of wall shall be permitted to fall outwardly from structures.
   2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
   3. Hot-work permits are required for any activity that includes torching/grinding/burning, etc. Wherever a cutting torch or other equipment that might cause a fire is used, provide and

maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.

4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

E. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.

F. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

G. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS and Section 01 35 26, SAFETY REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION:

A. Completely demolish and remove equipment, materials and structures, including all appurtenances related or connected thereto, as noted below:

1. As required for renovation of the existing Data Center and associated spaces.

B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

3.2 CLEAN-UP:

A. On completion of work of this section and after removal of all debris, leave the Area of Work in clean condition satisfactory to COR. Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

B. Contractor is responsible for provisions required for Winter Conditions for all construction situations. This may include temporary heating, shelters, snow removal, etc.

1.2 RELATED WORK

A. Section 01 45 29, TESTING LABORATORY SERVICES: Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN

A. Testing agency for the trial concrete mix design retained and reimbursed by the Contractor and approved by COR. For all other testing, refer to Section 01 45 29 Testing Laboratory Services.

B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.

C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

1.4 TOLERANCES

A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).

B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.

C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).

D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:
   1. Test entire slab surface, including those areas within 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
   2. Maximum elevation change which may occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
   3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (5 feet).

1.5 REGULATORY REQUIREMENTS

A. ACI SP-66 – ACI Detailing Manual.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ACI 301 – Standard Specifications for Structural Concrete.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES. All items indicated below are required submittals requiring Contracting Officer's Representative (COR) review and approval.

B. Shop Drawings: Reinforcing steel: Complete shop drawings

C. Mill Test Reports:
1. Reinforcing Steel.
2. Cement.

D. Manufacturer's Certificates:
1. Abrasive aggregate.
2. Lightweight aggregate for structural concrete.
3. Air-entraining admixture.
4. Chemical admixtures, including chloride ion content.
5. Waterproof paper for curing concrete.
6. Liquid membrane-forming compounds for curing concrete.
7. Non-shrinking grout.
8. Liquid hardener.
9. Waterstops.
10. Expansion joint filler.
11. Adhesive binder.

E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology and copy of report of latest CCRL, Inspection of Laboratory.

F. Test Report for Concrete Mix Designs: Trial mixes including water-cement fly ash ratio curves, concrete mix ingredients, and admixtures.

G. Test reports on splitting tensile strength (Fct) of lightweight concrete.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.

B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement and fly ash in separate suitable bins.

C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

1.8 PRE-CONCRETE CONFERENCE

A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.

B. Agenda: Includes but is not limited to:
1. Submittals.
2. Coordination of work.
3. Availability of material.
4. Concrete mix design including admixtures.
5. Methods of placing, finishing, and curing.
6. Finish criteria required to obtain required flatness and levelness.
7. Timing of floor finish measurements.

8. Material inspection and testing.

C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; lightweight aggregate manufacturer; admixture manufacturers; COR; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.

D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

1.9 MOCK-UP

A. In addition to the other specified samples and tests, construct a mock-up using the materials, reinforcing, forming system and construction methods proposed for use in exposed architectural concrete.

B. Construct the mock-up with at least a 2.5 m by 2.5 m (8 feet by 8 feet) exposed surface and suitable foundations. Include the following where applicable: Control joints, reglets, recesses or other typical architectural details.

C. Before casting the mock-up, submit full detailed Shop Drawings of the mock-up formwork for review by the Architect. Perform all necessary preliminary tests to ensure that concrete used for the mock-up will exactly match the approved sample in color and texture.

D. Perform the surface treatment proposed for use on one or more areas not less than 300 mm by 300 mm (1 foot by 1 foot) on the back side of the mock-up to establish the texture of finish required by the Architect. Repeat as required until a sample satisfactory to the Architect has been obtained.

E. Treat the finished front surface of the mock-up to produce a uniform appearance similar in every respect to the approved sample area.

F. The completed mock-up shall be inspected by the Architect. Failure of the mock-up to match the approved sample will require the construction of further mock-ups until approval is obtained. Remove rejected mock-ups immediately.

G. Maintain the approved mock-ups in good condition at the job site until all architectural concrete surfaces have been completed and approved by the Architect. Remove the mock-up from the site after completion of the above.

1.10 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

117-10	Specifications for Tolerances for Concrete Construction and Materials and Commentary
211.1-91(R2009)	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
211.2-98(R2004)	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
214R-11(R2019)	Guide to Evaluation of Strength Test Results of Concrete
301-16	Specifications for Structural Concrete
304R-00(R2009)	Guide for Measuring, Mixing, Transporting, and Placing Concrete
305.1-14	Specification for Hot Weather Concreting
306.1-90(R2002)	Standard Specification for Cold Weather Concreting
308.1-11	Specification for Curing Concrete

309R-05 ..... Guide for Consolidation of Concrete

318/318-19 ..... Building Code Requirements for Structural Concrete and Commentary

347R-14 ..... Guide to Formwork for Concrete

SP-66-04 ..... ACI Detailing Manual

C. American National Standards Institute and American Hardboard Association (ANSI/AHA):
A135.4-2012 ..... Basic Hardboard

D. ASTM International (ASTM):
A615/A615M-20 ..... Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A653/A653M-20 ..... Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

A706/A706M-16 ..... Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

A767/A767M-19 ..... Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement

A775/A775M-19 ..... Standard Specification for Epoxy Coated Steel Reinforcing Bars

A820/820M-16 ..... Standard Specification for Steel Fibers for Fiber Reinforced Concrete

A996/A996M-16 ..... Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement

A1064/A1064M-18a ..... Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C31/C31M-19a ..... Standard Practice for Making and Curing Concrete Test Specimens in the field

C33/C33M-18 ..... Standard Specification for Concrete Aggregates

C39/C39M-20 ..... Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

C94/C94M-19a ..... Standard Specification for Ready Mixed Concrete

C143/C143M-20 ..... Standard Test Method for Slump of Hydraulic Cement Concrete

C150C150M-20 ..... Standard Specification for Portland Cement

C171-16 ..... Standard Specification for Sheet Materials for Curing Concrete

C172C172M-17 ..... Standard Practice for Sampling Freshly Mixed Concrete

C173/C173M-16... ..... Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C192/C192M-19 ..... Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

C231/C231M-17a ..... Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C260/C260M-10a(2016) ..... Standard Specification for Air Entraining Admixtures for Concrete

C309-19 ..... Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

C330/C330M-17a ..... Standard Specification for Lightweight Aggregates for Structural Concrete

C494/C494M-19 ..... Standard Specification for Chemical Admixtures for Concrete

C618-19 ..... Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C666/C666M-15 ..... Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

C881/C881M-20 ..... Standard Specification for Epoxy Resin Base Bonding Systems for Concrete

C1107/1107M-20 ..... Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

C1315-19 ..... Standard Specification for Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete

D6/D6M-95(2018) ..... Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds

D297-15(2019) ..... Standard Test Methods for Rubber Products Chemical Analysis

D412—16 ..... Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

D1751-18 ..... Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D4263-83(2018) ..... Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

E1155-20 ..... Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers

F1249-20 ..... Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

F1869-16a ..... Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. American Welding Society (AWS):
D1.4/D1.4M-18 ..... Structural Welding Code – Steel Reinforcing Bars

F. Concrete Reinforcing Steel Institute (CRSI):
Handbook 2008

G. National Cooperative Highway Research Program (NCHRP):
Report On ..... Concrete Sealers for the Protection of Bridge Structures

H. U. S. Department of Commerce Product Standard (PS):
PS 1-07 ..... Structural Plywood

PS 20-20 ..... American Softwood Lumber Standard

I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:
CRD C513 ..... Rubber Waterstops

CRD C572 ..... Polyvinyl Chloride Waterstops

PART 2 - PRODUCTS

2.1 FORMS

A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.

B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.

C. Concrete products shall comply with following standards for biobased materials:

Material Type	Percent by Weight
Concrete Penetrating Liquid	79 percent biobased material
Concrete form Release Agent	87 percent biobased material
Concrete Sealer	11 percent biobased material

D. The minimum-content standards are based on the weight (not the volume)of the material.

E. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

2.2 MATERIALS

A. Portland Cement: ASTM C150 Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent. Do not exceed more than 25 percent total cementitious content by weight.

C. Coarse Aggregate: ASTM C33.
   1. Size 67 or Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
   2. Coarse aggregate for interior slabs on grade shall conform to the following:
      a. Dense or well graded aggregate.
         1) Percent retained on each sieve below the top size and above the No. 100 sieve:
            a) 8 to 18 percent for 1-1/2 inches (38 mm)top size.
            b) 8 to 22 percent for 3/4 or 1 inch (19 or 25 mm) top size.
         2) The above requirements may be deviated from based on locally available material.
            a) One or two non-adjacent sieves sizes may fall outside of the limits set above.
            b) Percent retained on two adjacent sieves sizes shall not be less than 5 percent of the above required.
            c) Percent retained on three adjacent sieve sizes shall not be less than 8 percent of the above required.
            d) When the percent retained on each of two adjacent sieve sizes is less than 8 percent the total percent retained on either of these sieves and the adjacent outside sieve should be at least 13 percent (for example, if both the No. 4 and No. 8 (4.75 and 2.36 mm)sieves have 6 percent retained on each item then: 1. the total retained on the 3/8 inch and No. 4 (9.5 and 4.75 mm) sieves should be at least 13 percent, and 2. the total retained on the No. 8 and No. 16 (2.36 and 1.18 mm) sieves should be at least 13 percent.

3. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.
4. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

D. Lightweight Aggregates for Structural Concrete: ASTM C330, Table 1. Maximum size of aggregate not larger than one-fifth of narrowest dimension between forms, nor three-fourth of minimum clear distance between reinforcing bars. Contractor to furnish certified report to verify that aggregate is sound and durable, and has a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C666.

E. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150 µm (No. 100) sieve.

F. Mixing Water: Fresh, clean, and potable.

G. Admixtures:
1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water. Use of superplasticizer requires COR approval.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260.
6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
7. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.

H. Vapor Barrier: ASTM F1249, 0.25 mm (10 mil) WVT 0.012 foot/hr.0.38 mm (15 mil) WVT 0.007 foot/hour .

I. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.

J. Welded Wire Fabric: ASTM A185.

K. Reinforcing Bars to be Welded: ASTM A706.

L. Reinforcement for Metal Pan Stair Fill: 50 mm (2 inch) wire mesh, either hexagonal mesh at .8Kg/m^2 (1.5 pounds per square yard), or square mesh at .6Kg/m^2 (1.17 pounds per square yard).

M. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.

N. Expansion Joint Filler: ASTM D1751.

O. Sheet Materials for Curing Concrete: ASTM C171.

P. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye, and shall meet the requirements of ASTM C1315.Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.

Q. Abrasive Aggregate: Aluminum oxide grains or emery grits.

R. Liquid Hardener and Dustproofer: Fluosilicate solution of magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer. Use only on exposed slab. Do not use where floor is covered with resilient flooring, paint or other finish coating.

S. Moisture Vapor Emissions & Alkalinity Control Sealer: 100 percent active colorless aqueous siliconate solution concrete surface.
   1. ASTM C1315 Type 1 Class A, and ASTM C309 Type 1 Class A, penetrating product to have no less than 34 percent solid content, leaving no sheen, volatile organic compound (VOC) content rating as required to suite regulatory requirements. The product shall have at least a five (5) year documented history in controlling moisture vapor emission from damaging floor covering, compatible with all finish materials.
   2. MVE 15-Year Warranty:
      a. When a floor covering is installed on a below grade, on grade, or above grade concrete slab treated with Moisture Vapor Emissions & Alkalinity Control Sealer according to manufacturer's instruction, sealer manufacturer shall warrant the floor covering system against failure due to moisture vapor migration or moisture-born contaminates for a period of fifteen (15) years from the date of original installation. The warranty shall cover all labor and materials needed to replace all floor covering that fails due to moisture vapor emission & moisture born contaminates.

T. Penetrating Sealer: For use on parking garage ramps and decks. High penetration silane sealer providing minimum 95 percent screening per National Cooperative Highway Research Program (NCHRP) No. 244 standards for chloride ion penetration resistance. Requires moist (non-membrane) curing of slab.

U. Non-Shrink Grout:
   1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (5000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.
   2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.

V. Adhesive Binder: ASTM C881.

W. Waterstops:
   1. Polyvinyl Chloride Waterstop: CRD C572.
   2. Rubber Waterstops: CRD C513.
   3. Bentonite Waterstop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 pounds per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
   4. Non-Metallic Hydrophilic: Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durameter and the volumetric expansion ratio in in 70 deg water shall be 3 to 1 minimum.

X. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).

Y. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.

Z. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.

AA. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

2.3 CONCRETE MIXES

A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
   1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
   2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m^3 (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement -fly ash ratio, and consistency of each cylinder in terms of slump. include dry unit weight of lightweight structural concrete.
   3. Prepare a curve showing relationship between water-cement -fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
   4. If the field experience method is used, submit complete standard deviation analysis.

B. Fly Ash Testing: Submit certificate verifying conformance with ASTM 618 initially with mix design and for each truck load of fly ash delivered from source. Submit test results performed within 6 months of submittal date. Notify the COR immediately when change in source is anticipated.
   1. Testing Laboratory used for fly ash certification/testing shall participate in the Cement and Concrete Reference Laboratory (CCRL) program. Submit most recent CCRL inspection report.

C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of the COR or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash , providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. The COR may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.

Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with maximum of 25 percent replacement by weight in all structural work. Increase this replacement to 40 percent for mass concrete, and reduce it to 10 percent for drilled piers and caissons. Fly ash shall not be used in high-early mix design.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio
35 (5000)[1,3]	375 (630)	0.45	385 (650)	0.40
30 (4000)[1,3]	325 (550)	0.55	340 (570)	0.50
25 (3000)[1,3]	280 (470)	0.65	290 (490)	0.55
25 (3000)[1,2]	300 (500)	See 4 below	310 (520)	See 4 below

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

4. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

D. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, MM (INCHES)

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

E. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

F. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

TABLE III - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 mm (3/4 in).4 to 8	25 mm (1 in).3-1/2 to 6-1/2
40 mm (1 1/2 in).3 to 6	

TABLE IV
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

G. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.

H. Lightweight structural concrete shall not weigh more than air-dry unit weight shown. Air-dry unit weight determined on 150 mm by 300 mm (6 inch by 12 inch) test cylinders after seven days standard moist curing followed by 21 days drying at 23 degrees C $\pm$ 1.7 degrees C (73.4 $\pm$ 3 degrees Fahrenheit), and 50 (plus or minus 7) percent relative humidity. Use wet unit weight of fresh concrete as basis of control in field.

I. Concrete slabs placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).

J. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. For air content requirements see Table III or Table IV.

K. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, the COR may require any one or any combination of the following corrective actions, at no additional cost to the Government:
1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, the COR may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, the COR may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the COR.

2.4 BATCHING AND MIXING

A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by the COR. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38 degrees C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the COR for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise the COR.

PART 3 - EXECUTION

3.1 FORMWORK:

A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.
1. Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and the COR approves their reuse.

2. Provide forms for concrete footings unless the COR determines forms are not necessary.

B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
3. Use sealer on reused plywood forms as specified for new material.

C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind of lumber used nor to develop deflection greater than 1/270 of free span of member.

D. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (18 inches) on center.
1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.

E. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.
1. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.
2. Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
3. Do not install sleeves in beams, joists or columns except where shown or permitted by the COR. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the COR, and require no structural changes, at no additional cost to the Government.
4. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.

F. Construction Tolerances:
1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 PLACING REINFORCEMENT

A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.

B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
   1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.
   2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.
   3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.

C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.

D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
   1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.
   2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength (fy) for the bars. Welding conform to the requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
      a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
      b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
      c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by the COR.
   3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength (fy) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
      a. Initial qualification: In the presence of the COR, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.
      b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.

E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by the COR.

F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.

G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

3.3 VAPOR BARRIER

A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier.

1. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
2. Vapor barrier joints lapped 150 mm (6 inches) and sealed with compatible waterproof pressure-sensitive tape.
3. Patch punctures and tears.

3.4 SLABS RECEIVING RESILIENT COVERING

A. Slab shall be allowed to cure for 6 weeks minimum prior to placing resilient covering. After curing, slab shall be tested by the Contractor for moisture in accordance with ASTM D4263 or ASTM F1869. Moisture content shall be less than 3 pounds per 1000 sf prior to placing covering.

B. In lieu of curing for 6 weeks, Contractor has the option, at his own cost, to utilize the Moisture Vapor Emissions & Alkalinity Control Sealer as follows:
1. Sealer is applied on the day of the concrete pour or as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade or above grade receiving resilient flooring, such as, sheet vinyl, vinyl composition tile, rubber, wood flooring, epoxy coatings and overlays.
2. Manufacturer's representative will be on the site the day of concrete pour to install or train its application and document. He shall return on every application thereafter to verify that proper procedures are followed.
    a. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
    b. Spray apply Sealer at the rate of 20 m^2 (200 square feet) per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
    c. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply Sealer product to these areas as soon as weather condition permits.

3.5 CONSTRUCTION JOINTS

A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (80 feet) in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by the COR.

B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.

C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.

D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.

E. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

3.6 EXPANSION JOINTS AND CONTRACTION JOINTS

A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.

B. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

C. Provide contraction (control) joints in floor slabs as indicated on the contract drawings. Joints shall be either formed or saw cut, to the indicated depth after the surface has been finished.

Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.7 PLACING CONCRETE

A. Preparation:
   1. Remove hardened concrete, wood chips, shavings and other debris from forms.
   2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
   3. Have forms and reinforcement inspected and approved by the COR before depositing concrete.
   4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.
   1. Preparing surface for applied topping:
      a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
      b. Broom clean and keep base slab wet for at least four hours before topping is applied.
      c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete is subject to approval of the COR.

D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.
   1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
   2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
   3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
   4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
   5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
   6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.
   7. Concrete on metal deck:
      a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.

1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.

E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.8 HOT WEATHER

A. Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by the COR.

3.9 COLD WEATHER

A. Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyantes or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by the COR.

3.10 PROTECTION AND CURING

A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by the COR.
1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m^2/L (400 square feet per gallon) on steel troweled surfaces and 7.5m^2/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.11 REMOVAL OF FORMS

A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours,

provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.

2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.

B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. For post-tensioned systems supporting forms and shoring not removed until stressing is completed. Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.

3.12 CONCRETE SURFACE PREPARATION

A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.

B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

3.13 CONCRETE FINISHES

A. Vertical and Overhead Surface Finishes:

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas will not require additional finishing.
2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical means approved by the COR, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
    a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
    b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600 µm (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.

c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.

4. Textured: Finish as specified. Maximum quantity of patched area 0.2 m^2 (2 square feet) in each 93 m^2 (1000 square feet) of textured surface.

B. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to the COR and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless the COR determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
8. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight

angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by the COR from sample panel.
11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
    a. Areas covered with carpeting, or not specified otherwise in b. below:
        1) Slab on Grade:
            a) Specified overall value: F_F 25/F_L 20
            b) Minimum local value: F_F 17/F_L 15
        2) Level suspended slabs (shored until after testing) and topping slabs:
            a) Specified overall value: FF 25/FL 20
            b) Minimum local value FF 17/FL 15
        3) Unshored suspended slabs:
            a) Specified overall value: FF 25
            b) Minimum local value: FF 17
        4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
    b. Areas that will be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:
        1) Slab on grade:
            a) Specified overall value: FF 36/FL 20
            b) Minimum local value: FF 24/FL 15
        2) Level suspended slabs (shored until after testing) and topping slabs
            a) Specified overall value: FF 30/FL 20
            b) Minimum local value: FF 24/FL 15
        3) Unshored suspended slabs:
            a) Specified overall value: FF 30
            b) Minimum local value: FF 24
        4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
    c. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
    d. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries may not cross a construction joint or expansion joint. A minimum local area will be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.
12. Measurements
    a. Department of Veterans Affairs retained testing laboratory will take measurements as directed by the COR, to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Make measurements before shores or forms are removed to insure the "as-built" levelness is accurately assessed. Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by Department of Veterans Affairs retained testing laboratory.
    b. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on

measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.

13. Acceptance/ Rejection:
    a. If individual slab section measures less than either of specified minimum local F_F/F_L numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.
    b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall F_F/F_L numbers, then whole slab shall be rejected and remedial measures shall be required.
14. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by the COR, until a slab finish constructed within specified tolerances is accepted.

3.14 SURFACE TREATMENTS:

A. Use on exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish .

B. Liquid Densifier/Sealer: Apply in accordance with manufacturer's directions just prior to completion of construction.

C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8 percent per 1/10th m^2 (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

3.15 APPLIED TOPPING

A. Separate concrete topping on floor base slab of thickness and strength shown. Topping mix shall have a maximum slump of 200 mm (8 inches) for concrete containing a high-range water-reducing admixture (superplasticizer) and 100 mm (4 inches) for conventional mix. Neatly bevel or slope at door openings and at slabs adjoining spaces not receiving an applied finish.

B. Placing: Place continuously until entire section is complete, struck off with straightedge, leveled with a highway straightedge or highway bull float, floated and troweled by machine to a hard dense finish. Slope to floor drains as required. Do not start floating until free water has disappeared and no water sheen is visible. Allow drying of surface moisture naturally. Do not hasten by "dusting" with cement or sand.

3.16 RESURFACING FLOORS

A. Remove existing flooring areas to receive resurfacing to expose existing structural slab and extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, and dampening. Apply specified bonding grout. Place topping while the bonding grout is still tacky.

3.17 RETAINING WALLS

A. Use air-entrained concrete.

B. Expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves installed and constructed as shown.

C. Exposed surfaces finished to match adjacent concrete surfaces, new or existing.

D. Place porous backfill as shown.

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Structural steel shapes, plates, and bars.
2. Structural pipe.
3. Bolts, nuts, and washers.

1.2 RELATED REQUIREMENTS

A. Materials Testing And Inspection During Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

C. Painting: Section 09 91 00, PAINTING.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Institute of Steel Construction (AISC):
1. AISC Manual - Steel Construction Manual, 15th Ed.
2. 303-16 - Code of Structural Steel Buildings and Bridges.
3. 360-16: Specification for Structural Steel Buildings.

C. The American Society of Mechanical Engineers (ASME):
1. B18.22.1-09 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers.

D. American Welding Society (AWS):
1. D1.1/D1.1M-17 - Structural Welding Code - Steel.

E. ASTM International (ASTM):
1. A6/A6M-14 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A36/A36M-14 - Carbon Structural Steel.
3. A53/A53M-12 - Pipe, Steel, Black and Hot-Dip, Zinc-Coated, Welded and Seamless.
4. A123/A123M-15 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. A242/A242M-13 - High-Strength Low-Alloy Structural Steel.
6. A283/A283M-13 - Low and Intermediate Tensile Strength Carbon Steel Plates.
7. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
8. A500/A500M-13 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
9. A501/A501M-14 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
10. A572/A572M-15 - High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
11. A992/A992M-15 - Structural Shapes.
12. F2329/F2329M-15 - Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy steel Bolts, Screws, washers, Nuts, and Special Threaded Fasteners.
13. F3125/F3125M-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

F. Master Painters Institute (MPI):
1. No. 18 - Primer, Zinc Rich, Organic.

G. Military Specifications (Mil. Spec.):
1. MIL-P-21035 - Paint, High Zinc Dust Content, Galvanizing, Repair.

H. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1926.752(e) - Guidelines For Establishing The Components Of A Site-Specific Erection Plan.
2. 29 CFR 1926-2001 - Safety Standards for Steel Erection.

I. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
1. Specification for Structural Joints Using ASTM F3125 Bolts.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.

C. Sustainable Construction Submittals:
1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

D. Test Reports: Certify products comply with specifications.
1. Welders' qualifying tests.

E. Certificates: Certify each product complies with specifications.
1. Structural steel.
2. Steel connections.
3. Welding materials.
4. Shop coat primer paint.

F. Qualifications: Substantiate qualifications comply with specifications.
1. Fabricator with project experience list .
2. Installer with project experience list .
3. Welders and welding procedures.

G. Record Surveys: Signed and sealed by responsible surveyor or engineer.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: AISC Quality Certification participant designated as AISC Certified Plant, Category STD.
1. Regularly fabricates specified products.
2. Fabricated specified products with satisfactory service on five similar installations for minimum five years.
a. Project Experience List: Provide contact names and addresses for completed projects.

B. Installer Qualifications: AISC Quality Certification Program participant designated as AISC-Certified Erector, Category ACSE.
1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.
a. Project Experience List: Provide contact names and addresses for completed projects.

C. Before commencement of Work, ensure steel erector provides written notification required by OSHA 29 CFR 1926.752(e). Submit a copy of the notification to Contracting Officer's Representative.

D. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.

1.6 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 MATERIALS

A. W-Shapes:
   1. ASTM A992/A992M.

B. M S -Shapes:
   1. ASTM A36/A36M.

C. Channel and Angles:
   1. ASTM A36/A36M.

D. Plates and Bars:
   1. ASTM A36/A36M.

E. Hollow Structural Sections:
   1. ASTM A500/A500M.

F. Structural Pipe: ASTM A53/A53M, Grade B.

G. Bolts, Nuts and Washers: Galvanized for galvanized framing and plain finish for other framing .
   1. High-strength bolts, including nuts and washers: ASTM F3125.
   2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
   3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ASME B18.22.1.

H. Welding Materials: AWS D1.1, type to suit application.

2.2 PRODUCTS - GENERAL

A. Sustainable Construction Requirements:
   1. Steel Recycled Content: 30 percent total recycled content, minimum.
   2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
      a. Paints and coatings.

2.3 FABRICATION

A. Fabricate structural steel according to Chapter M, AISC 360.

B. Shop and Field Connections:
   1. Weld connections according to AWS D1.1/D1.1M. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
   2. High-Strength Bolts: High-strength bolts tightened to a bolt tension minimum 70 percent of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

2.4 FINISHES

A. Shop Priming:
   1. Prime paint structural steel according to AISC 303, Section 6.
      a. Interstitial Space Structural Steel: Prime paint, unless indicated to receive sprayed on fireproofing.

B. Shop Finish Painting: Apply primer and finish paint as specified in Section 09 91 00, PAINTING.

C. Do not paint:
   1. Surfaces within 50 mm (2 inches) of field welded joints.
   2. Surfaces indicated to be encased in concrete.
   3. Surfaces receiving sprayed on fireproofing.
   4. Beam top flanges receiving shear connector studs applied.

D. Structural Steel Galvanizing: ASTM A123/A123M, hot dipped, after fabrication. Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.
   1. Galvanize structural steel framing installed at exterior locations.

E. Bolts, Nuts, and Washers Galvanizing: ASTM F2329, hot-dipped.

2.5 ACCESSORIES

A. General: Shop paint steel according to AISC 303, Section 6.

B. Finish Paint System: Primer and finish as specified in Section 09 91 00, PAINTING.

C. Galvanizing Repair Paint: MPI No. 18.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect structural steel according to AISC 303 and AISC 360.

B. Set structural steel accurately at locations and elevations indicated on drawings.

C. Maintain erection tolerances of structural steel within AISC 303 requirements.
   1. Pour Stop Elevation Tolerance: 6 mm (1/4 inch), maximum, before concrete placement.

D. Weld and bolt connections as specified for shop connections.

3.2 FIELD PAINTING

A. After welding, clean and prime weld areas to match adjacent finish.

B. Touch-up primer damaged by construction operations.

C. Apply galvanizing repair paint to galvanized coatings damaged by construction operations.

D. Finish Painting: As specified in Section 09 91 00, PAINTING.

3.3 FIELD QUALITY CONTROL

A. Record Survey:
   1. Engage registered land surveyor or registered civil engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS to perform survey.
   2. Measure and record structural steel framing plumbness, level, and alignment after completing bolting and welding and before installation of work supported by structural steel.
   3. Identify deviations from allowable tolerances specified in AISC Manual.

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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:
   1. Exterior non-load-bearing steel stud curtain wall.

1.2 RELATED WORK

A. Section 01 81 13 SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Section 05 12 00, STRUCTURAL STEEL FRAMING: Structural steel framing.

C. Section 05 12 00, STEEL JOIST FRAMING: Open web steel joists.

D. Section 09 22 16, NON-STRUCTURAL METAL FRAMING: Non-load-bearing metal stud framing assemblies.

E. Section 09 29 00, GYPSUM BOARD: Gypsum board assemblies.

1.3 DESIGN REQUIREMENTS

A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

B. Structural Performance: Engineer, fabricate and erect cold-formed metal framing with the minimum physical and structural properties indicated.

C. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
   1. Design Loads:
      a. Gravity, wind and seismic loading as indicated on the drawings or in this specification.
      b. Blast Loads:
         1) Light gauge framing in exterior walls shall be blast resistant and meet the following criteria per the VA Physical Security and Resiliency Design Manual.
         2) Standoff Distance: 25 feet (Life Safety Protected) 50 feet (Mission Critical Protected
         3) Design Threat in accordance with Table 6-1 of the referenced Physical Security and Resiliency Design Manual.
         4) Deformation not to exceed deformation limits shown in Table 6-2 of the referenced Physical Security and Resiliency Design Manual.
   2. Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-load-Bearing Curtain wall: Lateral deflection of 1/600 of the wall height.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).
   4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

5. Design exterior non-load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
6. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All items indicated below are required submittals requiring Contracting Officer's Representative (COR) review and approval

B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.

C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.

D. Design of the light gauge for this project shall be provided by the contractor's structural engineer for the loads shown on the construction documents. Submit signed and sealed calculations performed by a structural engineer with at least 5 years experience in the design of light gauge metal and registered in the state of the project. Calculations shall be submitted with plans elevations and details for review and approval.

E. Blast Design Calculations: Light Gauge Members and Connections
1. Submit calculations for review and approval prepared by qualified blast consultant, with a minimum of 5 years experience in design of blast resistant window systems when delegated designer of the light gauge responsible for design of light gauge members for gravity, wind and seismic loadings varies from minimum sizes required for blast loading shown on the drawings. The magnitudes of the design threats W1, W2 and GP1, GP2 are defined in the Physical Security and Resiliency Design Standards Data Definitions which is a document separate from the referenced VA Security and Resiliency Design Manual. The Physical Security and Resiliency Design Standards Data Definitions are provided on a need to know basis by the structural blast specialist performing the blast design on VA projects. It is the responsibility of the delegated engineer responsible for the design of blast resistant cold formed framing to request and obtain the Physical Security Design and Resiliency Data Standard Data Definitions from the VA Office of Construction and Facilities Management (CFM). Any associated delays or increased costs due to failure to obtain this information will be borne by the contractor.

F. Sustainable Construction Submittals:
1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Iron and Steel Institute (AISI): Specification and Commentary for the Design of Cold-Formed Steel Structural Members (2016)

C. ASTM International (ASTM):

A36/A36M-19	Standard Specification for Carbon Structural Steel
A123/A123M-17	Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-16a	Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A307-14e114 ..... Standard Specifications for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A653/A653M-20 ..... Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C955-18e1 ..... Standard Specification for Cold Formed Steel Structural Framing Members

C1107/1107M-20 ..... Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

E488/E488M-18 ..... Standard Test Methods for Strength of Anchors in Concrete Elements

E1190-11(2018) ..... Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

D. American Welding Society (AWS):
D1.3/D1.3M-18 ..... Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):
MIL-P-21035B ..... Paint, High Zinc Dust Content, Galvanizing Repair

F. VA Physical Security and Resiliency Design Manual October 1, 2020.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel for joists, studs and accessories 16 gauge and heavier: ASTM A653, structural steel, zinc coated G90, with a yield of 340 MPa (50 ksi) minimum.

B. Sheet Steel for joists, studs and accessories 18 gauge and lighter: ASTM A653, structural steel, zinc coated G90, with a yield of 230 MPa (33 ksi) minimum.

C. Galvanizing Repair Paint: MIL-P-21035B.

D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

2.2 WALL FRAMING

A. Steel Studs: Complying with ASTM C 955. Manufacturer's standard C-shaped steel studs of web depth indicated, with lipped flanges, and complying with the following:
   a. Minimum Base-Steel Thickness(uncoated): 1.09 mm (0.0428 inch)
   b. Flange Width: 1-5/8 inches
   2. Web: Punched .

B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:
   1. Design Uncoated-Steel Thickness: Matching steel studs.
   2. Flange Width: Manufacturer's standard deep flange where indicated, standard flange elsewhere.

2.3 FRAMING ACCESSORIES

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Gusset plates.
5. Deflection track and vertical slide clips.
6. Stud kickers and girts.
7. Reinforcement plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.

B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer’s standard elsewhere.

2.5 REQUIREMENTS

A. Welding in accordance with AWS D1.3

B. Furnish members and accessories by one manufacturer only.

PART 3 - EXECUTION

3.1 FABRICATION

A. Framing components may be preassembled into panels. Panels shall be square with components attached.

B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.

C. Hold members in place until fastened.

D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
   1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer’s instructions with screw penetrating joined members by not less than 3 exposed screw threads.

E. Where required, provide specified insulation in double header members and double jamb studs which will not be accessible after erection.

3.2 ERECTION

A. Handle and lift prefabricated panels in a manner as to not distort any member.

B. Securely anchor tracks to supports as shown.

C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.

D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.

F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.

G. Install headers in all openings that are larger than the stud spacing in that wall.

H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.

I. Studs in one piece for their entire length, splices will not be permitted.

J. Provide a load distribution member at top track where joist is not located directly over bearing stud.

K. Provide joist bridging and web stiffeners at reaction points where shown.

L. Provide end blocking where joist ends are not restrained from rotation.

M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.

N. Provide temporary bracing and leave in place until framing is permanently stabilized.

O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.

P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer’s standard punched openings.

3.3 TOLERANCES

A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.

B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.

C. Spacing of studs shall not be more than 3 mm (1/8 inch) +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

D. Prefabricated panels shall be not more than 3 mm (1/8 inch) +/- out of square within the length of that panel.

3.4 FIELD REPAIR

A. Touch-up damaged galvanizing with galvanizing repair paint.

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SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.

B. Items specified.
1. Support for Wall and Ceiling Mounted Items: (SD055000-01, SD055000-02, SD102113-01, SD102600-01, SD123100-01 & SD123100-02)
2. Frames
3. Guards
4. Covers and Frames for Pits and Trenches.
5. Gratings
6. Loose Lintels
7. Shelf Angles
8. Gas Racks
9. Plate Door Sill
10. Safety Nosings
11. Ladders
12. Railings:
13. Catwalks and Platforms
14. Trap Doors with Ceiling Hatch
15. Sidewalk Access Doors
16. Screened Access Doors
17. Steel Counter or Bench Top Frame and Leg
18. Steel Pipe Bollards

1.2 RELATED WORK

A. Prime and finish painting: Section 09 91 00, PAINTING.

B. Stainless steel corner guards: Section 10 26 00, WALL AND DOOR PROTECTION.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

Grating, each type	Floor plate
Trap door	Wheel guards
Ceiling hatch	Sidewalk Access door
Manhole Covers	Safety nosing

C. Shop Drawings:
1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
3. Provide templates and rough-in measurements as required.

D. Manufacturer's Certificates:
   1. Anodized finish as specified.
   2. Live load designs as specified.

E. Design Calculations for specified live loads including dead loads.

F. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

1.4 QUALITY ASSURANCE

A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each product type shall be the same and be made by the same manufacturer.

C. Assembled product to the greatest extent possible before delivery to the site.

D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):
   B18.6.1-97 ..... Wood Screws

   B18.2.2-87(R2010) ..... Square and Hex Nuts

C. American Society for Testing and Materials (ASTM):
   A36/A36M-14 ..... Structural Steel

   A47-99(R2014) ..... Malleable Iron Castings

   A48-03(R2012) ..... Gray Iron Castings

   A53-12 ..... Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

   A123-15 ..... Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

   A240/A240M-15 ..... Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

   A269-15 ..... Seamless and Welded Austenitic Stainless Steel Tubing for General Service

   A307-14e1 ..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

   A391/A391M-07(R2015) ..... Grade 80 Alloy Steel Chain

   A786/A786M-15 ..... Rolled Steel Floor Plate

   B221-14 ..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

   B456-11 ..... Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

   B632-08 ..... Aluminum-Alloy Rolled Tread Plate

   C1107-13 ..... Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

D3656-13 ..... Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

F436-16 ..... Hardened Steel Washers

F468-06(R2015) ..... Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws and Studs for General Use

F593-13 ..... Stainless Steel Bolts, Hex Cap Screws, and Studs

F1667-15 ..... Driven Fasteners: Nails, Spikes and Staples

F3125 / F3125M ..... Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

D. American Welding Society (AWS):
D1.1-15 ..... Structural Welding Code Steel

D1.2-14 ..... Structural Welding Code Aluminum

D1.3-18 ..... Structural Welding Code Sheet Steel

E. National Association of Architectural Metal Manufacturers (NAAMM)
AMP 521-01(R2012) ..... Pipe Railing Manual

AMP 500-06 ..... Metal Finishes Manual

MBG 531-09(R2017) ..... Metal Bar Grating Manual

MBG 532-09 ..... Heavy Duty Metal Bar Grating Manual

F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:
SP 1-15 ..... No. 1, Solvent Cleaning

SP 2-04 ..... No. 2, Hand Tool Cleaning

SP 3-04 ..... No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):
RR-T-650E ..... Treads, Metallic and Nonmetallic, Nonskid

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.

B. Ladders and Rungs: 120 kg (250 pounds) at any point.

C. Railings and Handrails: 900 N (200 pounds) in any direction at any point.

D. Floor Plates, Gratings, Covers, Trap Doors, Catwalks, and Platforms: 500 kg/m^2 (100 pounds per square foot). Use _____ kg (pounds) for concentrated loads. Use ____ kg/m^2 (pounds per square foot) for vehicle loads in the following areas : _____.

E. Manhole Covers: 1200 kg/m^2 (250 pounds per square foot).

2.2 MATERIALS

A. Structural Steel: ASTM A36.

B. Stainless Steel: ASTM A240, Type 302 or 304.

C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified. For structural shapes use alloy 6061-T6 and alloy 6061-T4511.

D. Floor Plate:
1. Steel ASTM A786.
2. Aluminum: ASTM B632.

E. Steel Pipe (Bollard): ASTM A53.
1. Galvanized for exterior locations.
2. Type S, Grade A unless specified otherwise.
3. NPS (inside diameter) as shown.

F. Cast-Iron: ASTM A48, Class 30, commercial pattern.

G. Malleable Iron Castings: A47.

H. Primer Paint: As specified in Section 09 91 00, PAINTING.

I. Stainless Steel Tubing: ASTM A269, type 302 or 304.

J. Modular Channel Units:
1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
2. Form channel within turned pyramid shaped clamping ridges on each side.
3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.

K. Grout: ASTM C1107, pourable type.

L. Insect Screening: ASTM D3656.

2.3 HARDWARE

A. Rough Hardware:
1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

B. Fasteners:
1. Bolts with Nuts:
a. ASME B18.2.2.
b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
c. ASTM F468 for nonferrous bolts.
d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.4 FABRICATION GENERAL

A. Material
1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.

2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:
1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections
1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
2. Field riveting will not be approved.
3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors
1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship
1. General:
   a. Fabricate items to design shown.
   b. Furnish members in longest lengths commercially available within the limits shown and specified.
   c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
   d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
   e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
   f. Prepare members for the installation and fitting of hardware.
   g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
   h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
2. Welding:
   a. Weld in accordance with AWS.
   b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.

c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
d. Finish welded joints to match finish of adjacent surface.

3. Joining:
   a. Miter or butt members at corners.
   b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Anchors:
   a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.
   b. Where metal fabrications are shown to be built into masonry use 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 250 mm (10 inches) long with 50 mm (2 inch) hooked end, welded to back of member at 600 mm (2 feet) on center, unless otherwise shown.
5. Cutting and Fitting:
   a. Accurately cut, machine and fit joints, corners, copes, and miters.
   b. Fit removable members to be easily removed.
   c. Design and construct field connections in the most practical place for appearance and ease of installation.
   d. Fit pieces together as required.
   e. Fabricate connections for ease of assembly and disassembly without use of special tools.
   f. f. Joints firm when assembled.
   g. Conceal joining, fitting and welding on exposed work as far as practical.
   h. Do not show rivets and screws prominently on the exposed face.
   i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:
1. Finish exposed surfaces in accordance with NAAMM AMP 500 Metal Finishes Manual.
2. Aluminum: NAAMM AMP 501.
   a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
   b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
   c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.
   d. Painted: AA-C22R10.
3. Steel and Iron: NAAMM AMP 504.
   a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
   b. Surfaces exposed in the finished work:
      1) Finish smooth rough surfaces and remove projections.
      2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
   c. Shop Prime Painting:
      1) Surfaces of Ferrous metal:
         a) Items not specified to have other coatings.
         b) Galvanized surfaces specified to have prime paint.
         c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
         d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.

e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.

2) Non ferrous metals: Comply with MAAMM-500 series.

4. Stainless Steel: NAAMM AMP-504 Finish No. 4.
5. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

G. Protection:
1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

2.5 SUPPORTS

A. General:
1. Fabricate ASTM A36 structural steel shapes as shown.
2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
3. Field connections may be welded or bolted.

B. For Wall Mounted Items:
1. For items supported by metal stud partitions.
2. Steel strip or hat channel minimum of 1.5 mm (0.0598 inch) thick.
3. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.
4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.
5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 100 mm (4 inches) on center between ends.

C. For Trapeze Bars:
1. Construct assembly above ceilings as shown and design to support not less than a 340 kg (750 pound) working load at any point.
2. Fabricate trapeze supports as shown, with all exposed members, including screws, nuts, bolts and washers, fabricated of stainless steel.
3. Fabricate concealed components of structural steel shapes unless shown otherwise.
4. Stainless steel ceiling plate drilled for eye bolt.
5. Continuously weld connections where welds shown.
6. Use modular channel where shown with manufacturers bolts and fittings.
a. Weld ends of steel angle braces to steel plates and secure to modular channel units as shown. Drill plates for anchor bolts.
b. Fabricate eye bolt, special clamp bolt, and plate closure full length of modular channel at ceiling line and secure to modular channel unit with manufacturers standard fittings.

D. For Intravenous Track and Cubical Curtain Track:
1. Fabricate assembly of steel angle as shown.
2. Drill angle bent ends for anchor screws to acoustical suspension system and angle for hanger wires.
3. Provide pipe sleeve welded to angle.

E. Supports at Ceiling for Radiographic (x-ray) Equipment:
1. Fabricate hangers braces, and track of modular channel units assembly as shown.
2. Fabricate steel plates for anchor to structure above.
3. Drill bent plates for bolting at mid height at concrete beams.

F. For Operating Room Light:

1. Fabricate as shown to suit equipment furnished.
2. Drill leveling plate for light fixture bolts.

G. Supports in Orthopedic Brace Shop:
1. Fabricate from 25 mm (one inch) steel pipe, fasten to steel angles above and extend to a point 150 mm (6 inches) below finished ceiling.
2. Lower end of the pipe shall have a standard pipe thread.
3. Provide an escutcheon plate at ceiling.

H. Supports for Accordion Partition Tracks, Exercise Equipment, and Items at Various Conditions at Suspended Ceilings:
1. Fabricate of structural steel shapes as shown.
2. Drill for anchor bolts of suspended item.

I. Supports for Communion Rail Posts in Chapel:
1. Fabricate one steel plate support for each post as shown.
2. Drill for fasteners.

2.6 FRAMES

A. Elevator Entrance Wall Opening.
1. Fabricate of channel shapes, plates, and angles as shown.
2. Weld or bolt head to jamb as shown.
3. Weld clip angles to bottom of frame and top of jamb members extended to structure above for framed construction.
   a. Provide holes for anchors.
   b. Weld head to jamb members.

B. Channel Door Frames:
1. Fabricate of structural steel channels of size shown.
2. Miter and weld frames at corners.
3. Where anchored to masonry or embedded in concrete, weld to back of frame at each jamb, 5 mm (3/16 inch) thick by 44 mm (1-3/4 inch) wide steel strap anchors with ends turned 50 mm (2 inches), and of sufficient length to extend at least 300 mm (12 inches) into wall. Space anchors 600 mm (24 inches) above bottom of frame and 600 mm (24 inches) o.c. to top of jamb. Weld clip angles to bottom of jambs and provide holes for expansion bolts.
4. Where anchored to concrete or masonry in prepared openings, drill holes at jambs for anchoring with expansion bolts. Weld clip angles to bottom of frame and provide holes for expansion bolt anchors as shown. Drill holes starting 600 mm (24 inches) above bottom of frame and 600 mm (24 inches) o.c. to top of jamb and at top of jamb. Provide pipe spacers at holes welded to channel.
5. Where closure plates are shown, continuously weld them to the channel flanges.
6. Weld continuous 19 x 19 x 3 mm (3/4 x 3/4 x 1/8 inch) thick steel angles to the interior side of each channel leg at the head and jambs to form a caulking groove.
7. Prepare frame for installation of hardware specified in Section 08 71 00, DOOR HARDWARE.
   a. Cut a slot in the lock jamb to receive the lock bolt.
   b. Where shown use continuous solid steel bar stops at perimeter of frame, weld or secure with countersunk machine screws at not more than 450 mm (18 inches) on center.

C. Frames for Breech Opening:
1. Fabricate from steel channels, or combination of steel plates and angles to size and contour shown.
2. Weld strap anchors on back of frame at not over 600 mm (2 feet) on centers for concrete or masonry openings.

D. Frames for Lead Lined Doors:

1. Obtain accurate dimensions and templates from suppliers of lead lined doors, finish hardware, and hollow steel door frames.
2. Fabricate as shown for use in connection with lead lined doors.
3. Deliver assembled frames with removable shipping spreaders at top and bottom.
4. Extend angles at jambs from floor to structural slab above. At floors of interstitial spaces, terminate jamb sections and provide anchors as shown.
5. Continuously weld plates and reinforcements to frame members and head members of angle frames between jambs.
6. Weld strap anchors, not over 600 mm (24 inches) on centers, to the back of angles for embedment in masonry or concrete unless shown otherwise.
7. Type 15 Door Frames:
    a. Structural steel angle frames with plate or bar full height to heads. Extend reinforcing at hinge cutouts two inches beyond cutout.
    b. Fabricate top anchorage to beam side at mid height.
    c. Weld clip angles to both legs of angle at top and bottom.
    d. Drill clips and plates, at top and bottom for anchoring jamb angles with two 9 mm (3/8 inch) expansion bolts at each location.
    e. Cut rabbet for pivot hinges and lock strike.

2.7 GUARDS

A. Wall Corner Guards:
1. Fabricate from steel angles and furnish with anchors as shown.
2. Continuously weld anchor to angle.

B. Guard Angles for Overhead Doors:
1. Cut away top portion of outstanding leg of angle and extend remaining portion of angle up wall.
2. Weld filler piece across head of opening to jamb angles.
3. Make provisions for fasteners and anchorage.

C. Channel Guard at Loading Platform:
1. Fabricate from steel channel of size shown.
2. Weld anchors to channels as shown.
3. Drill channel for bumper anchor bolts.

D. Edge Guard Angles for Openings in slabs.
1. 1. Fabricate from steel angles of sizes and with anchorage shown.
2. 2. Where size of angle is not shown, provide 50 x 50 x 6 mm (2 x 2 x 1/4 inch) steel angle with 32 x 5 mm (1-1/4 x 3/16 inch) strap anchors, welded to back.
3. Miter or butt angles at corners and weld.
4. Use one anchor near end and three feet on centers between end anchors.

E. Wheel Guards:
1. Construct wheel guards of not less than 16 mm (5/8 inch) thick cast iron.
2. Provide corner type, with flanges for bolting to walls.

2.8 COVERS AND FRAMES FOR PITS AND TRENCHES

A. Fabricate covers to support live loads specified.

B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating.

C. Steel Covers:
1. Use 6 mm (1/4 inch) thick floor plate for covers unless otherwise shown. Use gratings where shown as specified in paragraph GRATINGS. Use smooth floor plate unless noted otherwise.
2. Provide clearance at all sides to permit easy removal of covers.
3. Make cutouts within 6 mm (1/4 inch) of penetration for passage of pipes and ducts.
4. Drill covers for flat head countersunk screws.

5. Make cover sections not to exceed 2.3 m^2 (25 square feet) in area and 90 kg (200 pounds) in weight.
6. Fabricate trench cover sections not be over 900 mm (3 feet) long and if width of trench is more than 900 mm (3 feet)or over, equip one end of each section with an angle or "T" bar stiffener to support adjoining plate.
7. Use two, 13 mm (1/2 inch) diameter steel bar flush drop handles for each cover section.

D. Cast Iron Covers
1. Fabricate covers to support live loads specified.
2. Fabricate from ASTM A48, cast-iron, 13 mm (1/2 inch) minimum metal thickness, cast with stiffeners as required.
3. Fabricate as flush type with frame, reasonably watertight and be equipped with flush type lifting rings. Provide seals where watertight covers noted.
4. Make covers in sections not over 90 kg (200 pounds) except round covers.

E. E. Steel Frames:
1. Form frame from structural steel angles as shown. Where not shown use 63 x 63 x 6 mm (2-1/2 x 2-1/2 x 1/4 inch) angles for frame openings over 1200 mm (4 feet) long and 50 x 50 x 6 mm (2 ix 2 x 1/4 inch) for frame openings less than 1200 mm (4 feet).
2. Fabricate intermediate supporting members from steel "T's" or angles; located to support cover section edges.
3. Where covers are required use steel border bars at frames so that top of cover will be flush with frame and finish floor.
4. Weld steel strap anchors to frame. Space straps not over 600 mm (24 inches) o.c., not shown otherwise between end anchors. Use 6 x 25 x 200 mm (1/4 x 1 x 8 inches) with 50 mm (2 inch) bent ends strap anchors unless shown otherwise.
5. Drill and tap frames for screw anchors where plate covers occur.

F. Cast Iron Frames:
1. Fabricate from ASTM A48 cast iron to shape shown.
2. Provide anchors for embedding in concrete, spaced near ends and not over 600 mm (24 inches) apart.

2.9 GRATINGS

A. Fabricate gratings to support live loads specified and a concentrated load as specified.

B. Provide clearance at all sides to permit easy removal of grating.

C. Make cutouts in gratings with 6 mm (1/4 inch) minimum to 25 mm (one inch) maximum clearance for penetrations or passage of pipes and ducts. Edge band cutouts.

D. Fabricate in sections not to exceed 2.3 m^2 (25 square feet) in area and 90 kg (200 pounds) in weight.

E. Fabricate sections of grating with end-banding bars.

F. Fabricate angle frames and supports, including anchorage as shown.
1. Fabricate intermediate supporting members from "T's" or angles.
2. Locate intermediate supports to support grating section edges.
3. Fabricate frame to finish flush with top of grating.
4. Locate anchors at ends and not over 600 mm (24 inches) o.c.
5. Butt or miter, and weld angle frame at corners.

G. Steel Bar Gratings:
1. Fabricate grating using steel bars, frames, supports and other members shown in accordance with Metal Bar Grating Manual.
2. Galvanize steel members after fabrication in accordance with ASTM A123, G-90 for exterior gratings, gratings in concrete floors, and interior grating where specified.
3. Interior gratings: Prime paint unless specified galvanized.

H. Aluminum Bar Gratings:

1. Fabricate grating and frame assembly from aluminum as shown in accordance with Metal Bar Grating Manual.
2. Use 25 x 5 mm (1 x 3/16 inch) minimum size bearing bars.
3. Mill finish unless specified otherwise.

I. Plank Gratings:
1. Conform to Fed. Spec. RR-G-1602.
2. Manufacturers standard widths, lengths and side channels to meet live load requirements.
3. Galvanize exterior steel gratings ASTM A123, G-90 after fabrication.
4. Fabricate interior steel gratings from galvanized steel sheet, ASTM A525, where bearing on concrete or masonry.
5. Fabricate other interior grating from steel sheet and finish with shop prime paint. Prime painted galvanized sheet may be used.

J. Cast Iron Gratings:
1. Fabricate gratings to support a live load of 23940 Pa (500 pounds per square foot).
2. Fabricate gratings and frames for gutter type drains from cast-iron conforming to ASTM A48.
3. abricate gratings in section not longer than 1200 mm (4 feet) or over 90 kg (200 pounds) and fit so as to be readily removable.

2.10 LOOSE LINTELS

A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.

B. Fabricate lintels with not less than 150 mm (6 inch) bearing at each end for nonbearing masonry walls, and 200 mm (8 inch) bearing at each end for bearing walls.

C. Provide one angle lintel for each 100 mm (4 inches) of masonry thickness as follows except as otherwise specified or shown.
1. Openings 750 mm to 1800 mm (2-1/2 feet to 6 feet) - 100 x 90 x 8 mm (4 x 3-1/2 x 5/16 inch).
2. Openings 1800 mm to 3000 mm (6 feet to 10 feet) - 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).

D. For 150 mm (6 inch) thick masonry openings 750 mm to 3000 mm (2-1/2 feet to 10 feet) use one angle 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).

E. Provide bearing plates for lintels where shown.

F. Weld or bolt upstanding legs of double angle lintels together with 19 mm (3/4 inch bolts) spaced at 300 mm (12 inches) on centers.

G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.

H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.

I. Elevator Entrance:
1. Fabricate lintel from plate bent to channel shape, and provide a minimum of 100 mm (4 inch) bearing each end.
2. Cut away the front leg of the channel at each end to allow for concealment behind elevator hoistway entrance frame.

2.11 SHELF ANGLES

A. Fabricate from steel angles of size shown.

B. Fabricate angles with horizontal slotted holes for 19 mm (3/4 inch) bolts spaced at not over 900 mm (3 feet) on centers and within 300 mm (12 inches) of ends.

C. Provide adjustable malleable iron inserts for embedded in concrete framing.

2.12 PLATE DOOR SILL

A. Fabricate of checkered plate as detailed.
   1. Aluminum Plate: ASTM B632, 3 mm (0.125 inch) thick.
   2. Steel Plate: ASTM A786, 3 mm (0.125 inch thick), galvanized G90.

B. Fabricate for anchorage with flat head countersunk bolts at each end and not over 300 mm (12 inches), o.c.

2.13 SAFETY NOSINGS

A. Fed. Spec. RR-T-650, Type C.
   1. Aluminum: Class 2, Style 2.
   2. Cast iron: Class 4.

B. Fabricate nosings for exterior use from cast aluminum, and nosings for interior use from either cast aluminum or cast iron. Use one Class throughout.

C. Fabricate nosings approximately 100 mm (4 inches) wide with not more than 9 mm (3/8 inch) nose.

D. Provide nosings with integral type anchors spaced not more than 100 mm (4 inches) from each end and intermediate anchors spaced approximately 375 mm (15 inches) on center.

E. Fabricate nosings to extend within 100 mm (4 inches) of ends of concrete stair treads except where shown to extend full width.

F. Fabricate nosings to extend full width between stringers of metal stairs and full width of door openings.

G. On curved steps fabricate to terminate at point of curvature of steps having short radius curved ends.

2.14 LADDERS

A. Steel Ladders:
   1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.
   2. Fabricate angle brackets of 50 mm (2 inch) wide by 13 mm (1/2 inch) thick steel; brackets spaced maximum of 1200 mm (4 feet) apart and of length to hold ladder 175 mm (7 inches) from wall to center of rungs. Provide turned ends or clips for anchoring.
   3. Provide holes for anchoring with expansion bolts through turned ends and brackets.
   4. Where shown, fabricate side rails curved, twisted and formed into a gooseneck.
   5. Galvanize exterior ladders after fabrication, ASTM A123, G-90.

B. Aluminum Ladders:
   1. Fixed-rail type, constructed of structural aluminum, with mill finish.
   2. Fabricate side rails and rungs of size and design shown, with the rungs shouldered and headed into and welded to the rails.
   3. Where shown fabrication side rails curved, twisted and formed into gooseneck.
   4. Fabricate angle brackets at top and bottom and intermediate brackets where shown. Drill for bolting.

C. Ladder Rungs:
   1. Fabricate from 25 mm (one inch) diameter steel bars.
   2. Fabricate so that rungs will extend at least 100 mm (4 inches) into wall with ends turned 50 mm (2 inches), project out from wall 175 mm (7 inches), be 400 mm (16 inches) wide and be designed so that foot cannot slide off end.
   3. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

2.15 RAILINGS

A. In addition to the dead load design railing assembly to support live load specified.

B. B. Fabrication General:
1. Provide continuous welded joints, dressed smooth and flush.
2. Standard flush fittings, designed to be welded, may be used.
3. Exposed threads will not be approved.
4. Form handrail brackets to size and design shown.
5. Exterior Post Anchors.
   a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
   b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.
   c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts.
6. Interior Post Anchors:
   a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
   b. Weld or thread flanged fitting to posts at base.
   c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
   d. Provide sliding flange base plate on posts secured with set screws.
   e. Weld flange base plate to removable posts set in sleeves.

C. Handrails:
1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.

D. Steel Pipe Railings:
1. Fabricate of steel pipe with welded joints.
2. Number and space of rails as shown.
3. Space posts for railings not over 1800 mm (6 feet) on centers between end posts.
4. Form handrail brackets from malleable iron.
5. Fabricate removable sections with posts at end of section.
6. Removable Rails:
   a. Provide "U" shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.
   b. Secure rail to brackets with 9 mm (3/8 inch) stainless steel through bolts and nuts at top rail only when rails joined with vertical members.
   c. Continuously weld brackets to post.
   d. Provide slotted bolt holes in rail bracket.
   e. Weld bolt heads flush with top of rail.
   Weld flanged fitting to post where posts are installed in sleeves.
7. Opening Guard Rails:
   a. Fabricate rails with flanged fitting at each end to fit between wall opening jambs.
   b. Design flange fittings for fastening with machine screws to steel plate anchored to jambs.
   c. Fabricate rails for floor openings for anchorage in sleeves.
8. Gates:
   a. Fabricate from steel pipe as specified for railings.
   b. Fabricate gate fittings from either malleable iron or wrought steel.
   c. Hang each gate on suitable spring hinges of clamp on or through bolted type. Use bronze hinges for exterior gates.
   d. Provide suitable stops, so that gate will swing as shown.
9. Chains:
   a. Chains: ASTM A391, Grade 63, straight link style, normal size chain bar 8 mm (5/16 inch) diameter, eight links per 25 mm (foot) and with boat type snap hook on one end, and through type eye bolt on other end.

b. Fabricate eye bolt for attaching chain to pipe posts, size not less than 9 mm (3/8 inch) diameter.
c. Fabricate anchor at walls, for engagement of snap hook of either a 9 mm (3/8 inch) diameter eye bolt or punched angle.
d. Galvanize chain and bolts after fabrication.

E. Aluminum Railings:
1. Fabricate from extruded aluminum.
2. Use tubular posts not less than 3 mm (0.125 inch) wall thickness for exterior railings.
3. Punch intermediate rails and bottom of top rails for passage of posts and machine to a close fit.
4. Where shown use extruded channel sections for top rail with 13 mm (1/2 inch) thick top cover plates and closed ends.
5. Fabricate brackets of extruded or wrought aluminum as shown.
6. Fabricate stainless pipe sleeves with closed bottom at least six inches deep having internal dimensions at least 13 mm (1/2 inch) greater than external dimensions of posts where set in concrete.

F. Stainless Steel Railings:
1. Fabricate from 38 mm (1-1/2 inches) outside diameter stainless steel tubing, ASTM A269, having a wall thickness of 1.6 mm (0.065 inch).
2. Join sections by an internal connector to form hairline joints where field assembled.
3. Fabricate with continuous welded connections.
4. Fabricate brackets of stainless steel to design shown.
5. Fabricate stainless steel sleeves at least 150 mm (6 inches) deep having internal dimensions at least 13 mm (1/2 inch) greater than external dimensions of post.

2.16 CATWALKS

A. Fabricate catwalks including platforms, railings, ladders, supports and hangers, and arrangement of members as shown on drawings.

B. Fabricate steel ladders as specified under paragraph LADDERS unless shown otherwise.

C. Fabricate steel pipe railings as specified under paragraph RAILINGS.

D. Catwalk and platforms floor surfaces as shown.
1. Steel gratings as specified under paragraph gratings, either bar or plank type.
2. Steel floor plate.
3. Aluminum floor plate.

E. Prime paint catwalk system.

2.17 TRAP DOOR AND FRAMES WITH CEILING HATCH

A. Design to support a live load as specified.

B. Frames:
1. Fabricate steel angle frame to set in concrete slabs and design to set flush with finished concrete slab or curb. If not shown use 63 x 63 x 6 mm (2-1/2 x 2-1/2 x 1/4 inch) angles.
2. Miter steel angles at corners and weld together.
3. Weld steel bar stops to vertical leg of frame, to support doors flush with the top of the frame.
4. Weld steel strap anchors on each side not over 600 mm (24 inches) on center to the backs of the frames. If not shown use 6 x 50 x 200 mm (1/4 x 2 x 8 inch) long straps with 50 mm (2 inch bent) ends.
5. Form frames from steel angles with welded corners for reinforcing and bracing of well lining and support of ceiling hatch.

C. Covers:
1. Use 6 mm (1/4 inch) thick steel floor plate.
2. Where double leaf covers are shown, reinforce at meeting edges.

3. Use wrought steel hinges with fixed brass pins.
   a. Weld to cover.
   b. Secure to frame with machine screws.
4. Where ladders occur, install hinges on the side opposite the ladder.
5. Provide two bar type drop handles, flush with cover when closed for each leaf.

D. Well Lining:
1. Fabricate well linings, for access through concrete floor slabs and suspended ceilings, from hatch to ceiling hatch or ceiling openings.
2. Use steel sheet and shapes of size and thickness as shown. If not shown use 1.5 mm (0.0598 inch) thick steel sheet.
3. If not shown use 50 x 50 x 6 mm (2 x 2 x 1/4 inch) angle braces from ceiling level on each side angled at 45 degrees to structure above.
4. Use 25 x 25 x 3 mm (1 x 1 x 1/8 inch) angle bottom flange trim welded to well lining where no ceiling hatch occurs.

E. Ceiling Hatch:
1. Construct hatch with "T" or angle frame designed to support edge of ceiling and hatch, weld to well lining.
2. Form hatch panels of 3 mm (1/8 inch) steel, 5 mm (3/16 inch) aluminum or 1 mm (0.0359 inch) thick steel of pan type construction with 25 mm (one inch) of mineral fiber insulation between.
3. Use counter balance device, hinges, latch, hangers and other accessories required for installation and operation of hatch with not over 90 N (20 pounds) of force.
4. Fabricate panels flush and reinforced to remain flat.
5. Locate hatch panel flush with frame.

F. Finish with baked on prime coat.

2.18 SIDEWALK DOOR

A. Use flush, watertight, gutter type design.

B. Cover fabricate of 6 mm (1/4 inch) thick, diamond pattern floor plate.

C. Use automatic lock hold open feature and be hung on two flush type heavy bronze hinges capable of 90 degree swing on each door leaf.

D. Equip with locking and latching device and lifting devices; operable and accessible from both sides of doors.

E. Doors removable without disturbing frame.

F. Provide gutters at all joints for drainage of water.

2.19 SCREENED ACCESS DOORS AND FRAMES

A. Galvanized ASTM A123, G-90 after fabrication.

B. Wall frame:
1. Fabricate frame from steel angles or channels as shown.
2. Continuously weld 38 x 13 mm (1-1/2 x 1/2 inch) steel channel door stop to angle frame. Cut out lock strike opening in channel.
3. Miter and weld channel frame at corners. Reinforce corner with 3 mm (1/8 inch) plate angle.
4. Reinforce channel frame with 3 x 150 mm (1/8 x 6 inch) long steel plate at channel back to cutout for latch. Cutout lock strike opening in channel face. Drill and tap for hinge anchorage.
5. Drill jambs for 6 mm (1/4 inch) bolt anchors at top and bottom and not over 450 mm (18 inches) between top and bottom.
6. Fabricate frame for door to sit flush with face of frame.

C. Doors

1. Fabricate door using steel channel frame with 3 mm (1/8 inch) angle plate reinforcing at corners.
2. Miter and weld corners.
3. Fabricate lock box of 1.6 mm (1/16 inch) plate and weld to channel surround.
4. Provide wire mesh constructed of 3.5 mm (0.135 inch) diameter galvanized steel wire crimped and woven into 38 mm (1-1/2 inch) diamond mesh pattern. Fasten the wire mesh to door frames by bending the ends of each strand of wire over through channel clinched and welded to channel door frame.
5. Weld steel plate back-bands to channel door frame at hinge stiles only.
6. Screen on doors in exterior walls.
    a. Fabricate rewirable frame for screen from either extruded or tubular aluminum.
    b. Design to allow for removing or replacement frame and screening or adjoining items without damage.
    c. Use aluminum insect screening specified.
    d. Use stainless steel fasteners for securing screen to door.

D. Hardware:
1. Install hinged door to fixed frame with two 63 mm (2-1/2 inch) brass or bronze hinges.
2. Install lock or latch specified in Section 08 71 00, DOOR HARDWARE in lockbox.

2.20 STEEL COUNTER OR BENCH TOP FRAME AND LEGS

A. Fabricate channel or angle frame with mitered and welded corners as shown.

B. Drill top of frame with 6 mm (1/4inch) holes spaced 200 mm (8 inches) on center for securing countertop.

C. Fabricate legs of angle or pipe shapes and continuously weld to frame.

D. Finish frame with backed on enamel prime coat.

2.21 STEEL PIPE BOLLARD

A. Provide bollard in accordance with ASTM A53 with dimensions as shown in

B. standard detail SD320523-04. Anchor posts in concrete and fill solidly

C. with concrete with a minimum compressive strength of 17 MPa 2500psi.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Items set into concrete or masonry.
1. Provide temporary bracing for such items until concrete or masonry is set.
2. Place in accordance with setting drawings and instructions.
3. Build strap anchors, into masonry as work progresses.

C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.

D. Field weld in accordance with AWS.
1. Design and finish as specified for shop welding.
2. Use continuous weld unless specified otherwise.

E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.

F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.

G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.

H. Secure escutcheon plate with set screw.

3.2 INSTALLATION OF SUPPORTS

A. Anchorage to structure.
1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
2. Secure supports to concrete inserts by bolting or continuous welding as shown.
3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
4. Secure steel plate or hat channels to studs as detailed.

B. Ceiling Hung Toilet Stalls:
1. Securely anchor hangers of continuous steel channel above pilasters to structure above.
2. Bolt continuous steel angle at wall to masonry or weld to face of each metal stud.
3. Secure brace for steel channels over toilet stall pilasters to wall angle supports with bolts at each end spaced as shown.
4. Install diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
5. Install stud bolts in lower flange of channel before installing furred down ceiling over toilet stalls.
6. Install support for ceiling hung pilasters at entrance screen to toilet room similar to toilet stall pilasters.

C. Supports for Wall Mounted items:
1. Locate center of support at anchorage point of supported item.
2. Locate support at top and bottom of wall hung cabinets.
3. Locate support at top of floor cabinets and shelving installed against walls.
4. Locate supports where required for items shown.

D. Support at Ceiling for X-ray Tube Stand and Radiographic Equipment:
1. Bolt modular steel channel frames to hangers as shown, anchored to structure above.
2. Fasten frames with modular channel manufacturers fittings, bolts, and nuts. Space modular channel supports and hangers as shown and as required to suit equipment furnished.
3. Install closure plates in channels at ceiling where channel opening is visible. Coordinate and cut plates to fit tight against equipment anchors after equipment anchors are installed.

E. Ceiling Support for Operating Light:
1. Anchor support to structure above as shown.
2. Set leveling plate as shown level with ceiling.
3. Secure operating light to leveling plate in accordance with light manufacturer's requirements.

F. Supports for intravenous (IV) Track and Cubicle Curtain Track:
1. Install assembly where shown after ceiling suspension grid is installed.
2. Drill angle for bolt and weld nut to angle prior to installation of tile.

G. Support for cantilever grab bars:
1. Locate channels or tube in partition for support as shown, and extend full height from floor to underside of structural slab above.
2. Anchor at top and bottom with angle clips bolted to channels or tube with two, 9 mm (3/8 inch) diameter bolts.
3. Anchor to floors and overhead construction with two 9 mm (3/8 inch) diameter bolts.

4. Fasten clips to concrete with expansion bolts, and to steel with machine bolts or welds.

H. Supports for Trapeze Bars:
1. Secure plates to overhead construction with fasteners as shown.
2. Secure angle brace assembly to overhead construction with fasteners as shown and bolt plate to braces.
3. Fit modular channel unit flush with finish ceiling, and secure to plate with modular channel unit manufacturer's standard fittings through steel shims or spreaders as shown.
   a. Install closure plates in channel between eye bolts.
   b. Install eyebolts in channel.

I. Support for Communion Rail Posts:
1. Anchor steel plate supports for posts as shown.
2. Use four bolts per plate, locate two at top and two at bottom.
3. Use lag bolts.

3.3 COVERS AND FRAMES FOR PITS AND TRENCHES

A. Set frame and cover flush with finish floor.

B. Secure plates to frame with flat head countersunk screws.

C. Set gratings loose in drainage trenches or over pits unless shown anchored.

3.4 FRAMES FOR LEAD LINED DOORS

A. Secure jamb angle clips and plates, at top and bottom with two, 9 mm (3/8 inch) expansion bolts to concrete.

B. Secure 150 x 90 x 13 mm (6 x 3-1/2 x 1/2 inch) angle to steel framing for anchorage when expansion bolts to concrete is not possible.

C. Secure clips by welding to steel.

D. At interstitial spaces, anchor jamb angles as shown.

3.5 DOOR FRAMES

A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.

B. Level and plumb frame; brace in position required.

C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.

D. Set frames in formwork for frames cast into concrete.

E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

3.6 OTHER FRAMES

A. Set frame flush with surface unless shown otherwise.

B. Anchor frames at ends and not over 450 mm (18 inches) on centers unless shown otherwise.

C. Set in formwork before concrete is placed.

3.7 GUARDS

A. Steel Angle Corner Guards:
1. Build into masonry as the work progress.
2. Set into formwork before concrete is placed.
3. Set angles flush with edge of opening and finish floor or wall or as shown.
4. At existing construction fasten angle and filler piece to adjoining construction with 16 mm (5/8 inch) diameter by 75 mm (3 inch) long expansion bolts 450 mm (18 inches) on center.

5. Install Guard Angles at Edges of Trench, Stairwell, Openings in Slab, Dock Leveler, or Overhead Doors where shown.

B. Channel Guard at Top Edge of Concrete Platforms:
1. Install in formwork before concrete is placed.
2. Set channel flush with top of the platform.

C. Wheel Guards:
1. Set flanges of wheel guard at least 50 mm (2 inches) into pavement.
2. Anchor to walls as shown, expansion bolt if not shown.

3.8 GRATINGS

A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.

B. Set frame in formwork before concrete is placed.

C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.

D. Secure removable supporting members in place with stainless steel bolts.

E. Bolt gratings to supports.

3.9 STEEL LINTELS

A. Use lintel sizes and combinations shown or specified.

B. Install lintels with longest leg upstanding, except for openings in 150 mm (6 inch) masonry walls install lintels with longest leg horizontal.

C. Install lintels to have not less than 150 mm (6 inch) bearing at each end for nonbearing walls, and 200 mm (8 inch) bearing at each end for bearing walls.

3.10 SHELF ANGLES

A. Anchor shelf angles with 19 mm (3/4 inch) bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.

B. Provide expansion space at end of members.

3.11 PLATE DOOR SILL

A. Install after roofing base flashing and counter flashing work is completed.

B. Set in sealant and bolt to curb.

3.12 SAFETY NOSINGS

A. Except as specified and where preformed rubber treads are shown or specified install safety nosings at the following:
1. Exterior concrete steps.
2. Door sills of areaway entrances curbs.
3. Exposed edges of curbs of door sills at transformer and service rooms.
4. Interior concrete steps, including concrete filled treads of metal stairs of service stairs.

B. Install flush with horizontal and vertical surfaces.

C. Install nosing to within 100 mm (4 inches) of ends of concrete stair treads, except where shown to extend full width.

D. Extend nosings full width of door openings.

E. Extend nosings, full width between stringers of metal stairs, and terminate at point of curvature of steps having short radius curved ends.

3.13 LADDERS

A. Anchor ladders to walls and floors with expansion bolts through turned lugs or angle clips or brackets.

B. In elevator pits, set ladders to clear all elevator equipment where shown on the drawings.
1. Where ladders are interrupted by division beams, anchor ladders to beams by welding, and to floors with expansion bolts.
2. Where ladders are adjacent to division beams, anchor ladders to beams with bent steel plates, and to floor with expansion bolts.

C. C. Ladder Rungs:
1. Set ladder rungs into formwork before concrete is placed.
2. Set step portion of rung 150 mm (6 inches) from wall.
3. Space rungs approximately 300 mm (12 inches) on centers.
4. Where only one rung is required, locate it 400 mm (16 inches) above the floor.

3.14 RAILINGS

A. Steel Posts:
1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
2. Install sleeves in concrete formwork.
3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 92 00, JOINT SEALANTS-on exterior posts.
4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
5. Secure sliding flanged fittings to posts at base with set screws.
6. Secure fixed flanged fittings to concrete with expansion bolts.
7. Secure posts to steel with welds.

B. Aluminum Railing, Stainless Steel Railing, and Ornamental Railing Posts:
1. Install pipe sleeves in concrete formwork.
2. Set posts in sleeve and pour grout to surface on exterior locations and to within 6 mm (1/4 inch) of surface for interior locations except to where posts are required to be removable.
3. Apply beveled bead of urethane sealant over sleeve at post perimeter for exterior posts and flush with surface for interior posts as specified in Section 07 92 00, JOINT SEALANTS.

C. Anchor to Walls:
1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
   a. Anchor steel plate to concrete or solid masonry with expansion bolts.
   b. Anchor steel plate to hollow masonry with toggle bolts.
2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

D. Removable Rails:
1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

E. Gates:
1. Hang gate to swing as shown.
2. Bolt gate hinges to jamb post with clamp on or through bolts.

F. Chains:
1. Eye bolt chains to pipe posts.
2. Eye bolt anchoring at walls.

a. Expansion bolt to concrete or solid masonry.
b. Toggle bolt to hollow masonry of frame wall installed support.

G. Handrails:
1. Anchor brackets for metal handrails as detailed.
2. Install brackets within 300 mm (12 inches) of return of walls, and at evenly spaced intermediate points not exceeding 1200 mm (4 feet) on centers unless shown otherwise.
3. Expansion bolt to concrete or solid masonry.
4. Toggle bolt to installed supporting frame wall and to hollow masonry unless shown otherwise.

3.15 CATWALK AND PLATFORMS

A. Expansion bolt members to concrete unless shown otherwise.

B. Bolt or weld structural components together including ladders and stairs to support system.

C. Weld railings to structural framing.

D. Bolt or weld walk surface to structural framing.

E. Smooth field welds and spot prime damaged prime paint surface.

F. Fasten removable members with stainless steel fasteners.

3.16 SIDEWALK DOOR, TRAP DOORS, AND FRAMES

A. Set frame flush with finished concrete slab or curb.

B. Secure well linings to structure with expansion bolts unless shown otherwise.

C. Bolt ceiling hatch to well lining angle brace and to angle iron frames near corners and 300 mm (12 inches) on centers with not less than 9 mm (3/8 inch) roundhead machine screws.

D. Coordinate sidewalk door drain connections with plumbing work.

3.17 SCREENED ACCESS DOOR

A. Set frame in opening so that clearance at jambs is equal and secure with expansion bolts.

B. Use shims at bolts to prevent deformation of frame members in prepared openings.

C. Set frame in mortar bed and build in anchors as the masonry work progresses.

D. Grout jambs solid with mortar.

E. Secure insect screen to inside of door with stainless steel fasteners on doors in exterior walls.

3.18 STEEL COMPONENTS FOR MILLWORK ITEMS

A. Coordinate and deliver to Millwork fabricator for assembly where millwork items are secured to metal fabrications.

3.19 INSTALLATION OF STEEL PIPE BOLLARD

A. Set bollards vertically in concrete piers. Compressive strength of

B. concrete piers shall be 21MPa 3000psi. For dimensions of concrete piers

C. See standard detail SD320523-04.

3.20 CLEAN AND ADJUSTING

A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.

B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies wood blocking, sheathing, furring, nailers, and light wood construction.

1.2 RELATED WORK:

A. Sustainable design requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

B. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.

C. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:
   1. Postconsumer and preconsumer recycled content as specified in PART 2 - PRODUCTS.
   2. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
   3. For composite wood products, submit documentation indicating that product contains no added urea formaldehyde.

C. Manufacturer's Literature and Data:
   1. Submit data for lumber, panels, hardware and adhesives.
   2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   3. Submit data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   4. For products receiving a waterborne treatment, submit statement that moisture content of treated materials was reduced to levels specified before shipment to project site.

D. Manufacturer's certificate for unmarked lumber.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 152 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 QUALITY ASSURANCE:

A. Installer: A firm with a minimum of three (3) years' experience in the type of work required by this section.

1.6 GRADING AND MARKINGS:

A. Any unmarked lumber or plywood panel for its grade and species will not be allowed on VA Construction sites for lumber and material not normally grade marked, provide manufacturer's

certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material meet the specified the specified requirements.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Forest and Paper Association (AFPA):
NDS-15.....National Design Specification for Wood Construction
WCD1-01.....Details for Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):
A190.1-07.....Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):
B18.2.1-12(R2013).....Square and Hex Bolts and Screws
B18.2.2-10.....Square and Hex Nuts
B18.6.1-81(R2008).....Wood Screws

E. American Plywood Association (APA):
E30-11.....Engineered Wood Construction Guide

F. ASTM International (ASTM):
A653/A653M-13 .....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
C954-11.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness
C1002-14.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs
D198-14.....Test Methods of Static Tests of Lumber in Structural Sizes
D2344/D2344M-13.....Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
D2559-12a.....Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
D3498-03(R2011) .....Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
D6108-13.....Test Method for Compressive Properties of Plastic Lumber and Shapes
D6109-13.....Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products
D6111-13a.....Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement
D6112-13.....Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
F844-07a(R2013).....Washers, Steel, Plan (Flat) Unhardened for General Use
F1667-13.....Nails, Spikes, and Staples

G. American Wood Protection Association (AWPA):
AWPA Book of Standards

H. Commercial Item Description (CID):
A-A-55615 ..... Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Forest Stewardship Council (FSC):
FSC-STD-01-001(Ver. 4-0)FSC Principles and Criteria for Forest Stewardship

J. Military Specification (Mil. Spec.):
MIL-L-19140E..... Lumber and Plywood, Fire-Retardant Treated

K. Environmental Protection Agency (EPA):
40 CFR 59(2014) ..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

L. Truss Plate Institute (TPI):
TPI-85..... Metal Plate Connected Wood Trusses

M. U.S. Department of Commerce Product Standard (PS)
PS 1-95 ..... Construction and Industrial Plywood

PS 20-10 ..... American Softwood Lumber Standard

N. ICC Evaluation Service (ICC ES):
AC09 ..... Quality Control of Wood Shakes and Shingles

AC174 ..... Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)

PART 2 - PRODUCTS

2.1 LUMBER:

A. As required for blocking and MCR buildout only.

B. All lumber used in the Medical Facility shall be fire-treated/rated.

C. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

D. Structural Members: Species and grade as listed in the AFPA NDS having design stresses as shown.

E. Lumber Other Than Structural:
1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
2. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.
3. Board Sub-flooring: Shiplap edge, 25 mm (1 inch) thick, not less than 203 mm (8 inches) wide.

F. Sizes:
1. Conforming to PS 20.
2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

G. Moisture Content:

1. Maximum moisture content of wood products is to be as follows at the time of delivery to site.
   a. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
   b. Lumber over 50 mm (2 inches) thick: 25 percent or less.

H. Fire Retardant Treatment:
1. Comply with Mil Spec. MIL-L-19140.
2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

I. Preservative Treatment:
1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, sills, sole plates, furring, and sleepers that are less than 610 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members provided in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with AWPA Book use category system standards U1 and T1, except any process involving the use of Chromated Copper Arsenate (CCA) or other agents classified as carcinogenic for pressure treating wood is not permitted.

2.2 PLASTIC LUMBER:

A. General:
1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, are not to be less than design loads and spans indicated on contract documents.
2. Restricted to exterior use only.

B. Composite Plastic Lumber: Shapes made from a mixture of cellulose fiber and polyethylene or polypropylene.
1. Provide lumber with a minimum of 75 percent recycled content with a minimum of 25 percent post-consumer recycled content.
2. Decking Standard: ICC-ES AC109 or ICC-ES AC174.
3. Shear Parallel to Length: Maximum 6894 kPa (1,000 psi) in accordance with ASTM D2344/D2344M.
   Density: ASTM D6111.
4. Compressive Strength:
   a. Secant Modulus: Minimum 482,633 kPa (70,000 psi) in accordance with ASTM D6108.
   b. Stress at 3 percent strain: Minimum 10,342 kPa (1,500 psi) in accordance with ASTM D6108.
   c. Compression Parallel to Grain: Minimum 20,684 kPa (3,000 psi) in accordance with ASTM D6112.
   d. Compression Perpendicular to Grain: Minimum 6,894 kPa (1,000 psi) in accordance with ASTM D6112.
5. Flexural Strength: Minimum 13,789 kPa (2,000 psi) in accordance with ASTM D6109.
6. Tensile Strength: Minimum 8618 kPa (1,250 psi) in accordance with ASTM D198.
7. Surface Texture: Woodgrain Smooth

2.3 PLYWOOD:

A. Comply with PS 1.

B. Shall be fire-treated.

C. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

D. Sheathing:
   1. APA rated Exposure 1 or Exterior; panel grade CD or better.
   2. Wall sheathing:
      a. Minimum 9 mm (11/32 inch) thick with supports 406 mm (16 inches) on center and 12 mm (15/32 inch) thick with supports 610 mm (24 inches) on center unless specified otherwise.

2.4 ROUGH HARDWARE AND ADHESIVES:

A. Anchor Bolts:
   1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
   2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.

C. Washers
   1. ASTM F844.
   2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:
   1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
   2. Wood to Steel: ASTM C954, or ASTM C1002.

PART 3 - EXECUTION

3.1 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS:

A. As required for blocking and MCR build-out only.

B. Conform to applicable requirements of the following:
   1. AFPA NDS for timber connectors.
   2. AITC A190.1 Timber Construction Manual for heavy timber construction.
   3. AFPA WCD1 for nailing
   4. APA for installation of plywood or structural use panels.
   5. TPI for metal plate connected wood trusses.
   6. Space plastic lumber boards to allow for lengthwise expansion and contraction in accordance with manufacturer recommendations.

C. Fasteners:
   1. Bolts:
      a. Fit bolt heads and nuts bearing on wood with washers.
      b. Countersink bolt heads flush with the surface of nailers.
      c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
      d. Provide toggle bolts to hollow masonry or sheet metal.
      e. Provide bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 610 mm (24 inch) intervals between end bolts. Provide clips to beam flanges.
   2. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
      a. Shall be rated for installation in composite scenarios, metal/steel and fire rated lumber.

b. All fasteners shall be non-reactive to fire-treated lumber and shall not violate dissimilar metal interactions.
c. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
d. ASTM C954 for steel over 0.84 mm (0.033 inch) thick.

3. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
4. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
5. Screws to Join Wood:.
   a. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
6. Installation of Timber Connectors:
   a. Conform to applicable requirements of the AFPA NDS.
   b. Fit wood to connectors and drill holes for fasteners so wood is not split.

D. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

E. Blocking Nailers, and Furring:
1. Shall be fire-treated only.
2. Install furring, blocking, nailers, and grounds where shown.
3. Provide longest lengths practicable.
4. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
5. Layers of Blocking or Plates:
   a. Stagger end joints between upper and lower pieces.
   b. Fasten at ends and not over 610 mm (24 inches) between ends.
   c. Stagger fasteners from side to side of wood member over 127 mm (5 inches) in width.

F. Sheathing:
1. Provide plywood or structural-use panels for sheathing.
2. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and fastened over bearings as specified.
3. Set fasteners not less than 9 mm (3/8 inch) from edges.
4. Install 50 mm by 101 mm (2 inch by 4 inch) blocking spiked between joists, rafters and studs to support edge or end joints of panels.
5. Match and align sheathing which is an extension of work in place to existing.

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior 1" PWD applied to interior walls of IT closets.

B. Items specified:
1. Wall Paneling.

1.2 RELATED REQUIREMENTS

A. Woodwork Finish and Color: See Construction Documents.

B. Fabricated Metal brackets, bench supports and countertop legs: Section 05 50 00, METAL FABRICATIONS.

C. Gypsum Board: Section 09 29 00

D. Electrical light fixtures, communications equipment, security equipment and duplex outlets: Division 26, ELECTRICAL, Division 27, COMMUNICATIONS, and Division 28, SECURITY.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International:
A36/A36M-14 - .....Carbon Structural Steel.

A53/A53M-12 - .....Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

A240/A240M-15b - .....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

B26/B26M-14e1 - ..... Aluminum-Alloy Sand Castings.

B221-14 - .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

E84-15b - .....Surface Burning Characteristics of Building Materials.

C. American Hardboard Association (AHA):
A135.4-04 - .....Basic Hardboard.

D. Architectural Woodwork Institute (AWI):
AWI-09 - .....Architectural Woodwork Quality Standards and Quality Certification Program.

E. Builders Hardware Manufacturers Association (BHMA):
A156.9-10 - .....Cabinet Hardware.

A156.11-14 - .....Cabinet Locks.

A156.16-13 - .....Auxiliary Hardware.

F. Federal Specifications (Fed. Spec.):
A-A-1922A - .....Shield Expansion (Calking Anchors, Single Lead).

A-A-1936A - .....Adhesive, Contact, Neoprene Rubber.

FF-N-836E- Nut: .....Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding.

FF-S-111D(1) - .....Screw, Wood (Notice 1 inactive for new design).

MM-L-736C(1) - .....Lumber, Hardwood.

G. Hardwood Plywood and Veneer Association (HPVA):
HP1-09 - .....Hardwood and Decorative Plywood.

H. Military Specification (Mil. Spec):
MIL-L-19140E - .....Lumber and Plywood, Fire-Retardant Treated.

I. National Particleboard Association (NPA):
A208.1-09 - .....Wood Particleboard.

J. National Electrical Manufacturers Association (NEMA):
LD 3-05 - ..... High-Pressure Decorative Laminates.

K. U.S. Department of Commerce, Product Standard (PS):
PS1-07 - .....Construction and Industrial Plywood.

PS20-10 - .....American Softwood Lumber Standard.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
1. Required Participants:
   a. Contracting Officer's Representative.
   b. Architect/Engineer.and Interior Designer.
   c. VA Interior Designer.
   d. Contractor.
   e. Installer.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Installation schedule.
   b. Installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Installation.
   f. Terminations.
   g. Transitions and connections to other work.
   h. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:
1. Description of each products.
2. List of acceptable sealers for fire retardant materials.
3. Installation instructions.

D. Sustainable Construction Submittals:
1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
   a. Show volatile organic compound types and quantities.
   b. Certify each composite wood product contains no added urea formaldehyde.

E. Certificates: Certify products comply with specifications.
1. Fire retardant treatment of materials.

2. Moisture content of materials.

F. Qualifications: Substantiate qualifications comply with specifications.
1. Fabricator with project experience list.
2. Installer with project experience list.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications:
1. Regularly fabricates specified products.
2. Fabricated specified products with satisfactory service on five similar installations for minimum five years.

B. Installer Qualifications:
1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

D. Store products indoors in dry, weathertight facility.

E. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:
1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Conditions: HVAC systems are complete, operational, and maintaining facility design operating conditions continuously, beginning 48 hours before installation until Government occupancy.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.
4. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work is not complete and dry.

B. Field Measurements: Verify field conditions affecting plywood board fabrication and installation. Show field measurements on Submittal Drawings.
1. Coordinate field measurement and fabrication schedule to avoid delay.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design acoustical panel complying with specified performance:
1. Surface Burning Characteristics: When tested according to ASTM E84.
a. Flame Spread Rating: submit product rating for AE/VA review..
b. Smoke Developed Rating: 450 maximum.

2.2 MATERIALS

A. Grading and Marking: Factory mark with grade stamp lumber and plywood of inspection agency approved by the Board of Review, American Lumber Standard Committee.

B. Lumber:
1. Sizes:
a. Lumber Size references, unless otherwise specified, are nominal sizes, and actual sizes within manufacturing tolerances allowed by the standard under which product is produced.
b. Millwork, standing and running trim, and rails: Actual size as shown or specified.
2. Hardwood: MM-L-736, species as specified for each item.
3. Softwood: PS-20, exposed to view appearance grades:
a. Use C select or D select, vertical grain for transparent finish including stain transparent finish.
b. Use Prime for painted or opaque finish.
4. Use edge grain Wood members exposed to weather.
5. Moisture Content:
a. 32 mm (1-1/4 inches) or less nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.
b. Other materials: According to standards under which the products are produced.
6. Fire Retardant Treatment: Mil. Spec. MIL-L-19140E.
a. Treatment and performance inspection by an independent and qualified testing agency that establishes performance ratings.
b. Each piece of treated material bear identification of the testing agency and indicate performance according to such rating of flame spread and smoke developed.
c. Treat wood for maximum flame spread of 25 and smoke developed of 25.
d. Fire Resistant Softwood Plywood:
1) Grade A, Exterior, plywood for treatment.
2) Surface Burning Characteristics: When tested according to ASTM E84.
a) Flame spread: 0 to 25.
b) Smoke developed: 100 maximum.
e. Fire Resistant Hardwood Plywood:
1) Core: Fire retardant treated softwood plywood.
2) Hardwood face and back veneers untreated.
3) Factory seal panel edges.

C. Plywood:
1. Softwood Plywood: DOC PS1.
a. Plywood, 13 mm (1/2 inch) and thicker; minimum five ply construction, except 32 mm (1-1/4 inch) thick plywood minimum seven ply.
b. Plastic Laminate Plywood Cores:
1) Exterior Type, and species group.
2) Veneer Grade: A-C.
c. Shelving Plywood:
1) Interior Type, any species group.
2) Veneer Grade: A-B or B-C.
d. Other: As specified for item.
2. Hardwood Plywood: HPVA: HP.1.
a. Species of Face Veneer: As shown or as specified with each particular item.
b. Grade:
1) Transparent Finish: Type II (interior) A grade veneer.
2) Paint Finish: Type II (interior) Sound Grade veneer.
c. Species and Cut: Plain sliced red oak or rotary cut white birch unless specified otherwise.

1. Plastic Laminate: NEMA LD-3.

D. Exposed Laminate Surfaces including Countertops, and Sides of Cabinet Doors: Grade HGL.

E. Cabinet Interiors including Shelving: NEMA, CLS as a minimum, with the following:
   1. Plastic laminate clad plywood or particle board.
   2. Resin impregnated decorative paper thermally fused to particle board.

F. Plastic Laminate Covered Wood Tops Backing: Grade HGP.

G. Postformed Surfaces: Grade HGP.

H. Stainless Steel: ASTM A240, Type 302 or 304.

I. Cast Aluminum: ASTM B26.

J. Extruded Aluminum: ASTM B221.

2.3 PRODUCTS - GENERAL

A. Provide each product from one manufacturer.

B. Sustainable Construction Requirements:
   1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for the following products:
      a. Non-flooring adhesives and sealants.
      b. Paints and coatings.
      c. Wall base and accessories.
      d. Composite wood and agrifiber.

2.4 FABRICATION

A. General:
   1. AWI Custom Grade for interior millwork.
   2. Finish woodwork, free from pitch pockets.
   3. Trim, standard stock molding and members of same species, except where special profiles are shown.
   4. Plywood, minimum 13 mm (1/2 inch), unless otherwise shown on Drawings or specified.
   5. Edges of members in contact with concrete or masonry having a square corner caulking rebate.
   6. Fabricate members less than 4 m (14 feet) in length from one piece of lumber, back channeled and molded a shown.
   7. Fabricate interior trim and items of millwork to be painted from jointed, built-up, or laminated members, unless otherwise shown on Drawings or specified.

2.5 PLASTIC LAMINATE COUNTER OR WORK TOPS:

A. Thickness: 32 mm (1-1/4 inch) thick core unless shown otherwise.
   1. Edges:
      a. Decorative laminate for exposed edges of tops, back, and endsplash, 38 mm (1-1/2 inches) wide.
      b. Plastic or metal edges for top edges less than 38 mm (1-1/2 inches) wide.
   2. Assemble backsplash and end splash to counter top.
   3. Use one piece counters for straight runs.
   4. Miter corners for field joints with overlapping blocking on underside of joint.
   5. Fabricate wood counter for work benches as shown on Drawings.

2.6 ACCESSORIES

A. Hardware:
   1. Rough Hardware:
      a. Provide rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electric-galvanizing process. Galvanized where specified.
      b. Fasteners:
         1) Bolts with Nuts: FF-N-836.
         2) Expansion Bolts: A-A-1922A.

3) Screws: Fed. Spec. FF-S-111.

1. Finish Hardware:
    1. Cabinet Hardware: ANSI A156.9.
        1. Door/Drawer Pulls: B02011. Door in seismic zones: B03182.
        2. Drawer Slides: B05051 for drawers over 150 mm (6 inches) deep, B05052 for drawers 75 mm to 150 mm (3 to 6 inches) deep, and B05053 for drawers less than 75 mm (3 inches) deep.
        3. Sliding Door Tracks: B07063.
        4. Adjustable Shelf Standards: B4061 with shelf rest B04083.
        5. Concealed Hinges: B1601, minimum 110 degree opening.
        6. Butt Hinges: B01361, for flush doors, B01381 for inset lipped doors, and B01521 for overlay doors.
        7. Cabinet Door Catch: B0371 or B03172.
        8. Vertical Slotted Shelf Standard: B04103 with shelf brackets B04113, sized for shelf depth.
    2. Cabinet Locks: ANSI A156.11.
        1. Drawers and Hinged Door: E07262.
        2. Sliding Door: E07162.
    3. Auxiliary Hardware: ANSI A156.16.
        1. Shelf Bracket: B04041, japanned or enameled finish.
        2. Combination Garment rod and Shelf Support: B04051 japanned or enamel finish.
        3. Closet Bar: L03131 chrome finish of required length.
        4. Handrail Brackets: L03081 or L03101.
            1. Cast Aluminum, satin polished finish.
            2. Cast Malleable Iron, japanned or enamel finish.
    4. Steel Channel Frame and Leg supports for Counter top. Fabricated under Section 05 50 00, METAL FABRICATIONS.
    5. Pipe Bench Supports:
        1. Pipe: ASTM A53.
    6. Fabricated Wall Bench Supports:
        1. Steel Angles: ASTM A36 steel with chrome finish, or ASTM A167, stainless steel with countersunk wood screws, holes at 64 mm (2-1/2 inches) on center on horizontal member.
        2. Use 38 mm by 38 mm by 5 mm (1-1/2 by 1-1/2 by 3/16 inch) angle thick drilled for screw and bolt holes unless shown otherwise. Drill 6 mm (1/4 inch) holes for anchors on vertical member, maximum 200 mm (8 inches) on center between ends or corners.
        3. Stainless Steel Bars Brackets: ASTM A167, fabricated to shapes shown on Drawings, Number 4 finish. Provide 50 mm by 5 mm (2 inch by 3/16 inch) bars unless shown otherwise. Drill for anchors and screws. Drill countersunk wood screw holes at 64 mm (2-1/2 inches) on center on horizontal members and minimum two 13 mm (1/4 inch) hole for anchors on vertical member.
    7. Thru-Wall Counter Brackets:
        1. Steel angles drilled for fasteners on 100 mm (4 inches) centers.
        2. Baked enamel prime coat finish.
    8. Folding Shelf Bracket:
        1. Steel Shelf bracket, approximately 400 mm by 400 mm (16 by 16 inches), folding type, baked gray enamel finish or chrome plated finish.
        2. Bracket legs nominal 28 mm (1-1/8 inches) wide.
        3. Distance from center line of hinge pin to back of vertical leg to be 44 mm (1-3/4 inches) or provide for wood spacer when hinge line is at joint of vertical and horizontal leg.
        4. Distance from face to face of bracket when closed: 50 mm (2 inches).

5. Brackets shall automatically lock when counter is raised parallel to floor and unlock manually.
6. Each bracket capable of supporting a minimum of 68 kg (150 pounds), evenly distributed.

9. Edge Strips Moldings:
   1. Driven type "T" shape with serrated retaining stem; vinyl plastic to match plastic laminate color, stainless steel, or 3 mm (1/8 inch) thick extruded aluminum.
   2. Stainless steel or extruded aluminum channels.
   3. Stainless steel, number 4 finish; aluminum, mechanical applied medium satin finish, clear anodized 0.1 mm (0.4 mils) thick.
10. Rubber or Vinyl molding:
    1. Rubber or vinyl standard stock and in longest lengths practicable.
    2. Design for closures at joints with walls and adhesive anchorage.
    3. Adhesive as recommended by molding manufacturer.
11. Primers: Manufacturer's standard primer for steel providing baked enamel finish.

2. Adhesive:
   1. Plastic Laminate: Fed. Spec. A-A-1936.
   2. Interior Millwork: Unextended urea resin, unextended melamine resin, phenol resin, or resorcinol resin.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

3.2 INSTALLATION

A. Installation:
   1. Set nails for putty stopping. Provide washers under bolt heads where no other bearing plate occurs.
   2. Seal cut edges of fire retardant treated wood materials with a certified acceptable sealer.
   3. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.
   4. Plumb and level items unless shown otherwise.
   5. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.
   6. Apply adhesive uniformly for full contact between plywood and substrate.

B. Wall Paneling:
   1. Plywood Paneling:
      a. Install furring strips horizontally, 25 by 75 mm (1 by 3 inch) under end joints of plywood and 300 mm (16 inches) on center between end strips. Install cross furring strips centered vertically at side joints of plywood paneling less than 13 mm (1/2 inch) thick. Fasten each stud with two screws.
      b. Install panels with long edge vertically and end joints aligned where exposed to view.
      c. Align V-grooves where end joints meet and maintain continuity of pattern.
      d. Apply continuous bead of adhesive to each furring strip to securely bond panel according to adhesive manufacturer's specifications.
      e. Nailing:

1) Nail in V-grooves to horizontal furring strips and at panel edges and within 25 mm (1 inch) of ends except within 50 mm (2 inches) of end when panel end abutts other surfaces. Do not space nails in V-groves over 150 mm (6 inches), on center.
2) Nail ungrooved panels at 400 mm (16 inches) centers to horizontal furring strips between end or edge nails. Set nails and fill hole with filler to match wood panel for panels thicker than 13 mm (1/2 inch). Set nails flush with surface of panel thinner than 13 mm (1/2 inch).
3) Use colored nails matching panel finish for prefinished panels or panels less than 13 mm (1/2 inch) thick.

2. Edge Trim and Base: Install solid wood as shown on Drawings, species same as wall paneling.

3.3 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed surfaces. Remove contaminants and stains.

C. Touch up damaged factory finishes.
1. Repair painted surfaces with touch up primer.

3.4 PROTECTION

A. Protect finish carpentry from traffic and construction operations.

B. Cover finish carpentry with reinforced kraft paper, and plywood or hardboard.

C. Remove protective materials immediately before acceptance.

D. Repair damage.

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SECTION 07 21 13
THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies thermal and acoustical insulation for buildings.

B. Acoustical insulation is identified by thickness and words "Acoustical Insulation".

1.2 RELATED WORK

A. Safing insulation: Section 07 84 00, FIRESTOPPING.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES .

B. Manufacturer's Literature and Data:
1. Insulation, each type used
2. Adhesive, each type used.
3. Tape

C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.4 STORAGE AND HANDLING:

A. Store insulation materials in weathertight enclosure.

B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.5 APPLICABLE PUBLICATIONS:

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

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

C270-10.....Mortar for Unit Masonry

C516-08.....Vermiculite Loose Fill Thermal Insulation

C549-06.....Perlite Loose Fill Insulation

C552-07.....Cellular Glass Thermal Insulation.

C553-08.....Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C578-10.....Rigid, Cellular Polystyrene Thermal Insulation

C591-09.....Unfaced Preformed Rigid Cellular Polyisocynurate Thermal Insulation

C612-10.....Mineral Fiber Block and Board Thermal Insulation

C665-06.....Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

C728-05 (R2010) .....Perlite Thermal Insulation Board

C954-10 ..... Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Base to Steel Studs From 0.033 (0.84 mm) inch to 0.112 inch (2.84 mm) in thickness

C1002-07 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

D312-00(R2006) ..... Asphalt Used in Roofing

E84-10 ..... Surface Burning Characteristics of Building Materials

F1667-11 ..... Driven Fasteners: Nails, Spikes and Staples.

PART 2 - PRODUCTS

2.1 INSULATION – GENERAL:

A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.

B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.

C. Where more than one type of insulation is specified, the type of insulation for each use is optional, except use only one type of insulation in any particular area.

D. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Perlite composite board	23 percent post consumer recovered paper
Polyisocyanurate/polyurethane	
Rigid foam	9 percent recovered material
Foam-in-place	5 percent recovered material
Glass fiber reinforced	6 percent recovered material
Phenolic rigid foam	5 percent recovered material
Rock wool material	75 percent recovered material

E. The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.2 PERIMETER INSULATION IN CONTACT WITH SOIL:

A. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.

B. Cellular Glass Block: ASTM C552, Type I or IV.

2.3 EXTERIOR FRAMING OR FURRING INSULATION:

A. Batt or Blanket: Optional.

B. Mineral Fiber: ASTM C665, Type II, Class C, Category I where framing is faced with gypsum board.

C. Mineral Fiber: ASTM C665, Type III, Class A where framing is not faced with gypsum board.

2.4 2ACOUSTICAL INSULATION:

A. Mineral Fiber boards: ASTM C553, Type II, flexible, or Type III, semirigid (4.5 pound nominal density).

B. Mineral Fiber Batt or Blankets: ASTM C665. Maximum flame spread of 25 and smoke development of 450 when tested in accordance with ASTM E84.

C. Thickness as shown; of widths and lengths to fit tight against framing.

2.5 SOUND DEADENING BOARD:

A. Mineral Fiber Board: ASTM C612, Type IB, 13 mm (1/2 inch thick).

B. Perlite Board: ASTM C728, 13 mm (1/2 inch thick).

2.6 RIGID INSULATION:

A. On the inside face of exterior walls, spandrel beams, floors, bottom of slabs, and where shown.

B. Mineral Fiber Board: ASTM C612, Type IB or 2.

C. Perlite Board: ASTM C728.

D. Cellular Glass Block: ASTM C552, Type I.

2.7 MASONRY FILL INSULATION:

A. Vermiculite Insulation: ASTM C516, Type II.

B. Perlite Insulation: ASTM C549, Type IV.

2.8 FASTENERS:

A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.

B. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.

C. Impaling Pins: Steel pins with head not less than 50 mm (two inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

2.9 ADHESIVE:

A. As recommended by the manufacturer of the insulation.

B. Asphalt: ASTM D312, Type III or IV.

C. Mortar: ASTM C270, Type 0.

2.10 TAPE:

A. Pressure sensitive adhesive on one face.

B. Perm rating of not more than 0.50.

2.11 PART 3 - EXECUTION

2.12 INSTALLATION - GENERAL

A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.

B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.

C. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.

D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

2.13 PERIMETER INSULATION:

A. Vertical insulation:
1. Fill joints of insulation with same material used for bonding.
2. Bond polystyrene board to surfaces with adhesive or Portland cement mortar mixed and applied in accordance with recommendations of insulation manufacturer.
3. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.

B. B. Horizontal insulation under concrete floor slab:
1. Lay insulation boards and blocks horizontally on level, compacted and drained fill.
2. Extend insulation from foundation walls towards center of building not less than 600 mm (24 inches) or as shown.

2.14 EXTERIOR FRAMING OR FURRING BLANKET INSULATION:

A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.

B. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.

C. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.

D. Fasten blanket insulation between wood studs or framing with nails or staples through flanged edges on face of stud. Space fastenings not more than 150 mm (six inches) apart.

E. Roof Rafter Insulation or Floor Joist Insulation: Place mineral fiber blankets between framing to provide not less than a 50 mm (two inch) air space between insulation and roof sheathing or subfloor.

F. Ceiling Insulation and Soffit Insulation:
1. Fasten blanket insulation between wood framing or joist with nails or staples through flanged edges of insulation.
2. At metal framing or ceilings suspension systems, install blanket insulation above suspended ceilings or metal framing at right angles to the main runners or framing. Tape insulation tightly together so no gaps occur and metal framing members are covered by insulation.
3. In areas where suspended ceilings adjoin areas without suspended ceilings, install either blanket, batt, or mineral fiberboard extending from the suspended ceiling to underside of deck or slab above. Secure in place to prevent collapse or separation of hung blanket, batt, or board insulation and maintain in vertical position. Secure blanket or batt with continuous cleats to structure above.

2.15 RIGID INSULATION ON SURFACE OF EXTERIOR WALLS, FLOORS, AND UNDERSIDE OFFLOORS:

A. On the interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to the face of studs for interior wall finish where shown.

B. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer. Fill joints with adhesive cement.

C. Use impaling pins for attachment to underside of horizontal surfaces. Space fastenings as required to hold insulation in place and prevent sagging.

D. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings not more than 300 mm (12 inches) apart. Stagger fasteners at joints of boards. Install at each corner.

E. Floor insulation:
   1. Bond insulation to concrete floors in attic by coating surfaces with hot steep asphalt applied at rate of not less than 11.5 Kg per m² (25 lbs/100 sq. ft.), and firmly bed insulation therein.
   2. When applied in more than one layer, bed succeeding layers in hot steep asphalt applied at the rate of not less than 11.5 Kg per m² per m² lbs/100 sq. ft.).
   3. Contractors option: Insulation may be installed with nonflammable adhesive in accordance with the manufacturer's printed instructions when a separate vapor retarder is used.

2.16 MASONRY FILL INSULATION:

A. Pour fill insulation in voids of masonry units from tops of walls, or from sill where windows or other openings occur.

B. Pour in lifts of not more than 6 m (20 feet).

2.17 ACOUSTICAL INSULATION:

A. Fasten blanket insulation between metal studs and wall furring with continuous pressure sensitive tape along edges or adhesive.

B. Pack insulation around door frames and windows and in cracks, expansion joints, control joints, door soffits and other voids. Pack behind outlets, around pipes, ducts, and services encased in wall or partition. Hold insulation in place with pressure sensitive tape or adhesive.

C. Do not compress insulation below required thickness except where embedded items prevent required thickness.

D. Where acoustical insulation is installed above suspended ceilings install blanket at right angles to the main runners or framing. Extend insulation over wall insulation systems not extending to structure above.

E. Where semirigid insulation is used which is not full thickness of cavity, adhere to one side of cavity maintaining continuity of insulation and covering penetrations or embedments in insulation.

F. Where sound deadening board is shown, secure with adhesive to masonry or concrete walls and with screws to metal or wood framing. Secure sufficiently in place until subsequent cover is installed. Seal all cracks with caulking.

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SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Formed sheet metal work for wall and roof flashing, copings, roof edge metal, fasciae, drainage specialties, and formed expansion joint covers are specified in this section.

1.2 RELATED WORK

A. Flashing components of factory finished roofing and wall systems: Division 07 roofing and wall system sections.

B. Joint Sealants: Section 07 92 00, JOINT SEALANTS.

C. Color of factory coated exterior architectural metal and anodized aluminum items: See Construction Documents..

D. Paint materials and application: Section 09 91 00, PAINTING.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.

B. Aluminum Association (AA):

AA-C22A41 ..... Aluminum Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick

AA-C22A42 ..... Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 0.7 mils thick

AA-C22A44 ..... Chemically etched medium matte with electrolytically deposited metallic compound, integrally colored coating Class I Architectural, 0.7-mil thick finish

C. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

ANSI/SPRI ES-1-03 ..... Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

D. American Architectural Manufacturers Association (AAMA):

AAMA 620 ..... Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum

AAMA 621 ..... Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

E. ASTM International (ASTM):

A240/A240M-14 ..... Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

A653/A653M-11 ..... Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process

B32-08 ..... Solder Metal

B209-10 ..... Aluminum and Aluminum-Alloy Sheet and Plate

B370-12 ..... Copper Sheet and Strip for Building Construction

D173-03(R2011) ..... Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing

D412-06(R2013) ..... Vulcanized Rubber and Thermoplastic Elastomers-Tension

D1187-97(R2011) ..... Asphalt Base Emulsions for Use as Protective Coatings for Metal

D1784-11..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D3656-07..... Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

D4586-07..... Asphalt Roof Cement, Asbestos Free

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

G. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06 ..... Metal Finishes Manual

H. Federal Specification (Fed. Spec):
A-A-1925A..... Shield, Expansion; (Nail Anchors)

UU-B-790A..... Building Paper, Vegetable Fiber

I. International Code Commission (ICC): International Building Code, Current Edition

1.4 PERFORMANCE REQUIREMENTS

A. Wind Uplift Forces: Resist the following forces per FM Approvals 1-49:
1. Wind Zone 1: 1.00 to 1.44 kPa (21 to 30 lbf/sq. ft.): 2.87-kPa (60-lbf/sq. ft.) perimeter uplift force, 4.31-kPa (90-lbf/sq. ft.) corner uplift force, and 1.44-kPa (30-lbf/sq. ft.) outward force.
2. Wind Zone 2: 1.48 to 2.15 kPa (31 to 45 lbf/sq. ft.): 4.31-kPa (90-lbf/sq. ft.) perimeter uplift force, 5.74-kPa (120-lbf/sq. ft.) corner uplift force, and 2.15-kPa (45-lbf/sq. ft.) outward force.
3. Wind Zone 3: 2.20 to 4.98 kPa (46 to 104 lbf/sq. ft.): 9.96-kPa (208-lbf/sq. ft.) perimeter uplift force, 14.94-kPa (312-lbf/sq. ft.) corner uplift force, and 4.98-kPa (104-lbf/sq. ft.) outward force.

B. Wind Design Standard: Fabricate and install copings, roof-edge flashings tested per ANSI/SPRI ES-1 to resist design pressure. of the existing roof.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: For all specified items, including:
1. Flashings
1. Copings
2. Gravel Stop-Fascia
3. Expansion joints
4. Fascia-cant

C. Manufacturer's Literature and Data: For all specified items, including:
1. Two-piece counterflashing
2. Thru wall flashing
3. Expansion joint cover, each type
4. Nonreinforced, elastomeric sheeting
5. Fascia-cant

D. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Stainless Steel: ASTM A240, Type 302B, dead soft temper.

B. Copper ASTM B370, cold-rolled temper.

C. Aluminum Sheet: ASTM B209, alloy 3003-H14 except alloy used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.

D. Galvanized Sheet: ASTM, A653.

E. Nonreinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet (0.056 inch) thick. Sheeting shall have not less than 7 MPa (1,000 psi) tensile strength and not more than seven percent tension-set at 50 percent elongation when tested in accordance with ASTM D412. Sheeting shall show no cracking or flaking when bent through 180 degrees over a 1 mm (1/32 inch) diameter mandrel and then bent at same point over same size mandrel in opposite direction through 360 degrees at temperature of -30°C (-20 °F).

2.2 FLASHING ACCESSORIES

A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.

B. Rosin Paper: Fed-Spec. UU-B-790, Type I, Grade D, Style 1b, Rosin-sized sheathing paper, weighing approximately 3 Kg/10 m² (6 lbs/100 sf).

C. Bituminous Paint: ASTM D1187, Type I.

D. Fasteners:
   1. Use copper, copper alloy, bronze, brass, or stainless steel for copper and copper clad stainless steel, and stainless steel for stainless steel and aluminum alloy. Use galvanized steel or stainless steel for galvanized steel.
   2. Nails:
      a. Minimum diameter for copper nails: 3 mm (0.109 inch).
      b. Minimum diameter for aluminum nails 3 mm (0.105 inch).
      c. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.
      d. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.
   3. Rivets: Not less than 3 mm (1/8 inch) diameter.
   4. Expansion Shields: Fed Spec A-A-1925A.

E. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

F. Insect Screening: ASTM D3656, 18 by 18 regular mesh.

G. Roof Cement: ASTM D4586.

2.3 SHEET METAL THICKNESS

A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:

B. Concealed Locations (Built into Construction):
   1. Copper: 30g (10 oz) minimum 0.33 mm (0.013 inch thick).
   2. Stainless steel: 0.25 mm (0.010 inch) thick.
   3. Copper clad stainless steel: 0.25 mm (0.010 inch) thick.
   4. Galvanized steel: 0.5 mm (0.021 inch) thick.

C. Exposed Locations:
   1. Copper: 0.4 Kg (16 oz).
   2. Stainless steel: 0.4 mm (0.015 inch).
   3. Copper clad stainless steel: 0.4 mm (0.015 inch).

D. Thickness of aluminum or galvanized steel is specified with each item.

2.4 FABRICATION, GENERAL

A. Jointing:
   1. In general, copper, stainless steel and copper clad stainless steel joints, except expansion and contraction joints, shall be locked and soldered.
   2. Jointing of copper over 0.5 Kg (20 oz) weight or stainless steel over 0.45 mm (0.018 inch) thick shall be done by lapping, riveting and soldering.
   3. Joints shall conform to following requirements:
      a. Flat-lock joints shall finish not less than 19 mm (3/4 inch) wide.
      b. Lap joints subject to stress shall finish not less than 25 mm (one inch) wide and shall be soldered and riveted.
      c. Unsoldered lap joints shall finish not less than 100 mm (4 inches) wide.

B. Flat and lap joints shall be made in direction of flow.

C. Edges of bituminous coated copper, copper covered paper, nonreinforced elastomeric sheeting and polyethylene coated copper shall be jointed by lapping not less than 100 mm (4 inches) in the direction of flow and cementing with asphalt roof cement or sealant as required by the manufacturer's printed instructions.

D. Soldering:
   1. Pre tin both mating surfaces with solder for a width not less than 38 mm (1 1/2 inches) of uncoated copper, stainless steel, and copper clad stainless steel.
   2. Wire brush to produce a bright surface before soldering lead coated copper.
   3. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
   4. Completely remove acid and flux after soldering is completed.

E. Expansion and Contraction Joints:
   1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.
   2. Space joints as shown or as specified.
   3. Space expansion and contraction joints for copper, stainless steel, and copper clad stainless steel at intervals not exceeding 7200 mm (24 feet).
   4. Space expansion and contraction joints for aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
   5. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
   6. Fabricate joint covers of same thickness material as sheet metal served.

F. Cleats:
   1. Fabricate cleats to secure flashings and sheet metal work over 300 mm (12 inches) wide and where specified.
   2. Provide cleats for maximum spacing of 300 mm (12 inch) centers unless specified otherwise.
   3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
   4. Fabricate cleats from 50 mm (2 inch) wide strip. Form end with not less than 19 mm (3/4 inch) wide loose lock to item for anchorage. Form other end of length to receive nails free of item to be anchored and end edge to be folded over and cover nail heads.

G. Edge Strips or Continuous Cleats:

1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
2. Except as otherwise specified, fabricate edge strips or minimum 0.6 Kg (24 ounce)copper, or 0.6 mm (0.024 inch) thick stainless steel or 1.25 mm (0.050 inch) thick aluminum.
3. Use material compatible with sheet metal to be secured by the edge strip.
4. Fabricate in 3000 mm (10 feet) maximum lengths with not less than 19 mm (3/4 inch) loose lock into metal secured by edge strip.
5. Fabricate Strips for fascia anchorage to extend below the supporting wood construction to form a drip and to allow the flashing to be hooked over the lower edge at least 19 mm (3/4-inch).
6. Fabricate anchor edge maximum width of 75 mm (3 inches) or of sufficient width to provide adequate bearing area to insure a rigid installation using 1 Kg (32 oz) copper or 0.8 mm (0.031 inch) thick stainless steel or 1.6 mm (0.0625 inch) thick aluminum.

H. Drips:
1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, gravel stops, wall copings, by folding edge back 13 mm (1/2 inch) and bending out 45 degrees from vertical to carry water away from the wall.
2. Form drip to provide hook to engage cleat or edge strip for fastening for not less than 19 mm (3/4 inch) loose lock where shown.

I. Edges:
1. Edges of flashings concealed in masonry joints opposite drain side shall be turned up 6 mm (1/4 inch) to form dam, unless otherwise specified or shown otherwise.
2. Finish exposed edges of flashing with a 6 mm (1/4 inch) hem formed by folding edge of flashing back on itself when not hooked to edge strip or cleat. Use 6 mm (1/4 inch) minimum penetration beyond wall face with drip for through-wall flashing exposed edge.
3. All metal roof edges shall meet requirements of IBC, current edition.

J. Metal Options:
1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.
3. Where copper gravel stops, copings and flashings will carry water onto cast stone, stone, or architectural concrete, or stainless steel.

2.5 FINISHES

A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.

B. In accordance with NAAMM Metal Finishes Manual AMP 500, unless otherwise specified.

C. Finish exposed metal surfaces as follows, unless specified otherwise:
1. Copper: Mill finish.
2. Stainless Steel: Finish No. 2B or 2D.
3. Aluminum:
   a. Clear Finish: AA-C22A41 medium matte, clear anodic coating, Class 1 Architectural, 18 mm (0.7 mils) thick.
   b. Colored Finish: AA-C22A42 (anodized) or AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 18 mm (0.7 mils) thick. Dyes will not be accepted.
   c. Fluorocarbon Finish: AAMA 620, high performance organic coating.
   d. Mill finish.
4. Steel and Galvanized Steel:
   a. Finish painted under Section 09 91 00, PAINTING unless specified as prefinished item.
   b. Manufacturer's finish:

1) Baked on prime coat over a phosphate coating.
2) Baked-on prime and finish coat over a phosphate coating.
3) Fluorocarbon Finish: AAMA 621, high performance organic coating.

2.6 THROUGH-WALL FLASHINGS

A. Form through-wall flashing to provide a mechanical bond or key against lateral movement in all directions. Install a sheet having 2 mm (1/16 inch) deep transverse channels spaced four to every 25 mm (one inch), or ribbed diagonal pattern, or having other deformation unless specified otherwise.
   1. Fabricate in not less than 2400 mm (8 feet) lengths; 3000 mm (10 feet) maximum lengths.
   2. Fabricate so keying nests at overlaps.

B. For Masonry Work When Concealed Except for Drip:
   1. Either copper, stainless steel, or copper clad stainless steel.
   2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
   3. Form exposed portions of flashing with drip, approximately 6 mm (1/4 inch) projection beyond wall face.

C. For Masonry Work When Exposed Edge Forms a Receiver for Counter Flashing:
   1. Use same metal and thickness as counter flashing.
   2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
   3. Form exposed portion as snap lock receiver for counter flashing upper edge.

D. For Flashing at Architectural Precast Concrete Panels or Stone Panels.
   1. Use plan flat sheet of stainless steel.
   2. Form exposed portions with drip as specified or receiver.

E. Window Sill Flashing and Lintel Flashing:
   1. Use either copper, stainless steel, copper clad stainless steel plane flat sheet, or nonreinforced elastomeric sheeting, bituminous coated copper, copper covered paper, or polyethylene coated copper.
   2. Fabricate flashing at ends with folded corners to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening.
   3. Turn up back edge as shown.
   4. Form exposed portion with drip as specified or receiver.

F. Door Sill Flashing:
   1. Where concealed, use either 0.5 Kg (20 oz) copper, 0.5 mm (0.018 inch) thick stainless steel, or 0.5 mm (0.018 inch) thick copper clad stainless steel.
   2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use either 0.6 Kg (24 ounce) copper, 0.6 mm (0.024 inch) stainless steel, or 0.6 mm (0.024 inch) thick stainless steel.
   3. Fabricate flashing at ends to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening with folded corners.

2.7 BASE FLASHING

A. Use metal base flashing at vertical surfaces intersecting built-up roofing without cant strips or where shown.
   1. Use either copper, or stainless steel, thickness specified unless specified otherwise.
   2. When flashing is over 250 mm (10 inches) in vertical height or horizontal width use either 0.5 Kg (20 oz) copper or 0.5 mm (0.018 inch) stainless steel.
   3. Use stainless steel at aluminum roof curbs where flashing contacts the aluminum.
   4. Use either copper, or stainless steel at pipe flashings.

B. Fabricate metal base flashing up vertical surfaces not less than 200 mm (8 inch) nor more than 400 mm (16 inch).

C. Fabricate roof flange not less than 100 mm (4 inches) wide unless shown otherwise. When base flashing length exceeds 2400 mm (8 feet) form flange edge with 13 mm (1/2 inch) hem to receive cleats.

D. Form base flashing bent from strip except pipe flashing. Fabricate ends for riveted soldered lap seam joints. Fabricate expansion joint ends as specified.

E. Pipe Flashing: (Other than engine exhaust or flue stack)
   1. Fabricate roof flange not less than 100 mm (4 inches) beyond sleeve on all sides.
   2. Extend sleeve up and around pipe and flange out at bottom not less than 13 mm (1/2 inch) and solder to flange and sleeve seam to make watertight.
   3. At low pipes 200 mm (8 inch) to 450 mm (18 inch) above roof:
      a. Form top of sleeve to turn down into the pipe at least 25 mm (one inch).
      b. Allow for loose fit around and into the pipe.

F. At high pipes and pipes with goosenecks or other obstructions which would prevent turning the flashing down into the pipe:
   1. Extend sleeve up not less than 300 mm (12 inch) above roofing.
   2. Allow for loose fit around pipe.

2.8 COUNTERFLASHING (CAP FLASHING OR HOODS)

A. Either copper or stainless steel, unless specified otherwise.

B. Fabricate to lap base flashing a minimum of 100 mm (4 inches) with drip:
   1. Form lock seams for outside corners. Allow for lap joints at ends and inside corners.
   2. In general, form flashing in lengths not less than 2400 mm (8 feet) and not more than 3000 mm (10 feet).
   3. Two-piece, lock in type flashing may be used in-lieu-of one piece counter-flashing.
   4. Manufactured assemblies may be used.
   5. Where counterflashing is installed at new work use an integral flange at the top designed to be extended into the masonry joint or reglet in concrete.
   6. Where counterflashing is installed at existing work use surface applied type, formed to provide a space for the application of sealant at the top edge.

C. One-piece Counterflashing:
   1. Back edge turned up and fabricate to lock into reglet in concrete.
   2. Upper edge formed to extend full depth of masonry unit in mortar joint with back edge turned up 6 mm (1/4 inch).

D. Two-Piece Counterflashing:
   1. Receiver to extend into masonry wall depth of masonry unit with back edge turned up 6 mm (1/4 inch) and exposed edge designed to receive and lock counterflashing upper edge when inserted.
   2. Counterflashing upper edge designed to snap lock into receiver.

E. Surface Mounted Counterflashing; one or two piece:
   1. Use at existing or new surfaces where flashing cannot be inserted in vertical surface.
   2. One piece fabricate upper edge folded double for 65 mm (2 1/2 inches) with top 19 mm (3/4 inch) bent out to form "V" joint sealant pocket with vertical surface. Perforate flat double area against vertical surface with horizontally slotted fastener holes at 400 mm (16 inch) centers between end holes. Option: One piece surface mounted counter-flashing (cap flashing) may be used. Fabricate as detailed on Plate 51 of SMACNA Architectural Sheet Metal Manual.
   3. Two pieces: Fabricate upper edge to lock into surface mounted receiver. Fabricate receiver joint sealant pocket on upper edge and lower edge to receive counterflashing, with slotted fastener holes at 400 mm (16 inch) centers between upper and lower edge.

F. Pipe Counterflashing:

G. Form flashing for water-tight umbrella with upper portion against pipe to receive a draw band and upper edge to form a "V" joint sealant receiver approximately 19 mm (3/4 inch) deep.

H. Fabricate 100 mm (4 inch) over lap at end.

I. Fabricate draw band of same metal as counter flashing. Use 0.6 Kg (24 oz) copper or 0.33 mm (0.013 inch) thick stainless steel or copper coated stainless steel.

J. Use stainless steel bolt on draw band tightening assembly.

K. Vent pipe counter flashing may be fabricated to omit draw band and turn down 25 mm (one inch) inside vent pipe.

A. Where vented edge decks intersect vertical surfaces, form in one piece, shape to slope down to a point level with and in front of edge-set notched plank; then, down vertically, overlapping base flashing.

2.9 GRAVEL STOPS

A. General:
1. Fabricate in lengths not less than 2400 mm (8 feet) long and maximum of 3000 mm (10 feet).
2. Fabricate internal and external corners as one-piece with legs not less than 600 mm (2 feet) or more than 1200 mm (4 feet) long.
3. Fabricate roof flange not less than 100 mm (4 inches) wide.
4. Fabricate top edge to extend above roof not less than 25 mm (one inch) for embedded gravel aggregate and not less than 100 mm (4 inches) for loose laid ballast.
5. Fabricate lower edge outward at an angle of 45 degrees to form drip and as fascia or as counter flashing as shown:
   a. Fabricate of one-piece material of suitable width for fascia height of 250 mm (10 inch) maximum or counterflashing lap of not less than 100 mm (4 inch) over base flashing.
   b. Fabricate bottom edge of formed fascia to receive edge strip.
   c. When fascia bottom edge forms counter flashing over roofing lap roofing not less than 150 mm (6 inches).

B. Formed Flat Sheet Metal Gravel Stops and Fascia:
1. Fabricate as shown of.05 mm (0.018 inch) thick stainless steel or 0.5 Kg (20 ounce) copper 1.25 mm (0.050 inch) thick aluminum.
2. When fascia exceeds 150 mm (6 inches) in depth, form one or more horizontal stops not less than 13 mm (1/2 inch) high in the fascia.
3. Fabricate as two-piece fascia when fascia depth exceeds 250 mm (10 inches).
4. At joint between ends of sheets, provide a concealed clip soldered or welded near one end of each sheet to hold the adjoining sheet in lapped position. The clip shall be approximately 100 mm (4 inches) wide and shall be the full depth of the fascia less 25 mm (one inch) at top and bottom. Clip shall be of the same thickness as the fascia.
5. Provide edge strip as specified with lower hooked edge bent outward at an angle of 45 degrees.

C. Formed (Corrugated Sheet) Sheet Metal Gravel Stops and Fascia:
1. Fabricate as shown of 0.4 mm (0.015 inch) thick stainless steel or 0.5 Kg (16 ounce) copper or 0.8 mm (0.032 inch) thick aluminum.
2. Sheets shall have 2 mm (1/16 inch) deep corrugations either transversely or diagonally rolled into the sheet. Crimped sheets are not acceptable.
3. Factory fabricate prepackaged system, complete with fastenings.
4. Provide concealed flashing splice plate at joints not less than 150 mm (6 inches) long and continuous edge strip at lower edge of fascia made from same metal.
5. Fabricate as two-piece fascia when fascia depth exceeds 175 mm (7 inches).

2.10 REGLETS

A. Fabricate reglets of one of the following materials:

1. 0.4 Kg (16 ounce) copper.
2. Stainless steel, not less than 0.3 mm (0.012 inch) thick.
3. Plastic coated extruded aluminum, not less than 1.4 mm (0.055 inch) thick prefilled with butyl rubber sealer and complete with plastic wedges inserted at 1000 mm (40 inches) on centers.
4. Plastic, ASTM D1784, Type II, not less than 2 mm (0.075 inch) thick.

B. Fill open-type reglets with fiberboard or other suitable separator, to prevent crushing of the slot during installation.

C. Bend edges of reglets for setting into concrete to an angle of not less than 45 degrees, and make wide enough to provide firm anchorage in the concrete.

D. Fabricate reglets for building into horizontal masonry mortar joints not less than 19 mm (3/4 inch) deep, nor more than 25 mm (one inch) deep.

E. Fabricate mitered corners, fittings, and special shapes as may be required by details.

F. Reglets for concrete may be formed to receive flashing and have a 10 mm (3/8 inch), 45 degree snap lock.

2.11 INSULATED EXPANSION JOINT COVERS

A. Either type optional, use only one type throughout.

B. Types:
1. Construct of two preformed, stainless steel strips, not less than 0.4 mm (0.015 inch) thick, mechanically and adhesively bonded to both sides of a 2 mm (1/16 inch) thick neoprene or butyl sheet, or to a 0.4 mm (32 mil) thick reinforced chlorinated polyethylene sheet. Adhesively attach a 10 mm (3/8 inch) thick sheet of closed cell, neoprene foam insulation, to the underside of the neoprene, butyl, or chlorinated polyethylene sheet.
2. Constructed of a 2 mm (1/16 inch) thick vinyl sheet, flanged at both sides with stainless steel strips not less than 0.4 mm (0.015 inch) thick. Vinyl sheet locked and encased by the stainless steel strip and prepunched for nailing. A 10 mm (3/8 inch) thick closed cell polyvinyl chloride foam insulating strip shall be heat laminated to the underside of the vinyl sheet between the stainless steel strips.

C. Expansion joint covers shall have factory fabricated mitered corners, crossing tees, and other necessary accessories. Furnish in the longest available lengths.

D. Metal flange of sufficient width to extend over the top of the curb and down curb sides 50 mm (2 inches) with hemmed edge for lock to edge strip.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
2. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
3. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
4. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
5. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.

6. Apply a layer of 7 Kg (15 pound) saturated felt followed by a layer of rosin paper to wood surfaces to be covered with copper. Lap each ply 50 mm (2 inch) with the slope and nail with large headed copper nails.
7. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nail not over 100 mm (4 inches) on center unless specified otherwise.
8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.
9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.
10. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:
    a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
    b. Paint dissimilar metal with a coat of bituminous paint.
    c. Apply an approved caulking material between aluminum and dissimilar metal.
15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
16. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.
17. Bitumen Stops:
    a. Install bitumen stops for built-up roof opening penetrations through deck and at formed sheet metal gravel stops.
    b. Nail leg of bitumen stop at 300 mm (12 inch) intervals to nailing strip at roof edge before roofing material is installed.

3.2 THROUGH-WALL FLASHING

A. General:
1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of masonry building walls; at top of concrete floors; under masonry, concrete, or stone copings and elsewhere as shown.
2. Where exposed portions are used as a counterflashings, lap base flashings at least 100 mm (4 inches)and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing as specified.
4. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge where not part of counter flashing.
5. Turn back edge up 6 mm (1/4 inch) unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 38 mm (1 1/2 inch) into unit unless shown otherwise.
7. Under copings terminate both edges beyond face of wall approximately 6 mm (1/4 inch) with drip edge.
8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.

9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 25 mm (1 inch) and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.
13. When flashing terminates in reglet extend flashing full depth into reglet and secure with lead or plastic wedges spaced 150 mm (6 inch) on center.
14. Continue flashing around columns:
    a. Where flashing cannot be inserted in column reglet hold flashing vertical leg against column.
    b. Counterflash top edge with 75 mm (3 inch) wide strip of saturated cotton unless shown otherwise. Secure cotton strip with roof cement to column. Lap base flashing with cotton strip 38 mm (1 1/2 inch).

B. Flashing at Veneer Walls:
1. Install near line of finish floors over shelf angles or where shown.
2. Turn up against sheathing.
3. At stud framing, hem top edge 19 mm (3/4 inch) and secure to each stud with stainless steel fasteners through sheathing.
4. At concrete backing, extend flashing into reglet as specified.
5. Coordinate with installation of waterproofing or asphalt felt for lap over top of flashing.

C. Lintel Flashing when not part of shelf angle flashing:
1. Install flashing full length of lintel to nearest vertical joint in masonry over veneer.
2. Turn ends up 25 mm (one inch) and fold corners to form dam and extend end to face of wall.
3. Turn back edge up to top of lintel; terminate back edge as specified for back-up wall.

D. Window Sill Flashing:
1. Install flashing to extend not less than 100 mm (4 inch) beyond ends of sill into vertical joint of masonry or veneer.
2. Turn back edge up to terminate under window frame.
3. Turn ends up 25 mm (one inch) and fold corners to form dam and extend to face of wall.

E. Door Sill Flashing:
1. Install flashing under bottom of plate sills of doors over curbs opening onto roofs. Extend flashing out to form counter flashing or receiver for counter flashing over base flashing. Set in sealant.
2. Extend sill flashing 200 mm (8 inch) beyond jamb opening. Turn ends up one inch in vertical masonry joint, extend end to face of wall. Join to counter flashing for water tight joint.
3. Where doors thresholds cover over waterproof membranes install sill flashing over water proof membrane under thresholds. Extend beyond opening to cover exposed portion of waterproof membrane and not less than 150 mm (6 inch) beyond door jamb opening at ends. Turn up approximately 6 mm (1/4 inch) under threshold.

F. Flashing at Masonry, Stone, or Precast Concrete Copings:
1. Install flashing with drips on both wall faces unless shown otherwise.
2. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

3.3 BASE FLASHING

A. Install where roof membrane type base flashing is not used and where shown.

1. Install flashing at intersections of roofs with vertical surfaces or at penetrations through roofs, to provide watertight construction.
2. Install metal flashings and accessories having flanges extending out on top of the built-up roofing before final bituminous coat and roof aggregate is applied.
3. Set flanges in heavy trowel coat of roof cement and nail through flanges into wood nailers over bituminous roofing.
4. Secure flange by nailing through roofing into wood blocking with nails spaced 75 mm (3 inch) on centers or, when flange over 100 mm (4 inch) wide terminate in a 13 mm (1/2 inch) folded edge anchored with cleats spaced 200 mm (8 inch) on center. Secure one end of cleat over nail heads. Lock other end into the seam.

B. For long runs of base flashings install in lengths of not less than 2400 mm (8 feet) nor more than 3000 mm (ten feet). Install a 75 mm (3 inch) wide slip type, loose lock expansion joint filled with sealant in joints of base flashing sections over 2400 mm (8 feet) in length. Lock and solder corner joints at corners.

C. Extend base flashing up under counter flashing of roof specialties and accessories or equipment not less than 75 mm (3 inch).

3.4 COUNTERFLASHING (CAP FLASHING OR HOODS)

A. General:
1. Install counterflashing over and in conjunction with installation of base flashings, except as otherwise specified or shown.
2. Install counterflashing to lap base flashings not less than 100 mm (4 inch).
3. Install upper edge or top of counterflashing not less than 225 mm (9 inch) above top of the roofing.
4. Lap joints not less than 100 mm (4 inch). Stagger joints with relation to metal base flashing joints.
5. Use surface applied counterflashing on existing surfaces and new work where not possible to integrate into item.
6. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete or masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.

B. One Piece Counterflashing:
1. Where flashing is installed at new masonry, coordinate to insure proper height, embed in mortar, and end lap.
2. Where flashing is installed in reglet in concrete insert upper edge into reglet. Hold flashing in place with lead wedges spaced not more than 200 mm (8 inch) apart. Fill joint with sealant.
3. Where flashing is surface mounted on flat surfaces.
    a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:
        1) Locate fasteners in masonry mortar joints.
        2) Use screws to sheet metal or wood.
    b. Fill joint at top with sealant.
4. Where flashing or hood is mounted on pipe.
    a. Secure with draw band tight against pipe.
    b. Set hood and secure to pipe with a one by 25 mm x 3 mm (1 x 1/8 inch) bolt on stainless steel draw band type clamp, or a stainless worm gear type clamp.
    c. Completely fill joint at top with sealant.

C. Two-Piece Counterflashing:
1. Where receiver is installed at new masonry coordinate to insure proper height, embed in mortar, and lap.
2. Surface applied type receiver:
    a. Secure to face construction in accordance, with manufacturers instructions.
    b. Completely fill space at the top edge of receiver with sealant.

3. Insert counter flashing in receiver in accordance with fabricator or manufacturer's instructions and to fit tight against base flashing.

D. Where vented edge occur install so lower edge of counterflashing is against base flashing.

E. When counter flashing is a component of other flashing install as shown.

3.5 REGLETS

A. Install reglets in a manner to provide a watertight installation.

B. Locate reglets not less than 225 mm (9 inch) nor more than 400 mm (16 inch) above roofing, and not less than 125 mm (5 inch) nor more than 325 mm (13 inch) above cant strip.

C. Butt and align end joints or each section of reglet and securely hold in position until concrete or mortar are hardened:
1. Coordinate reglets for anchorage into concrete with formwork construction.
2. Coordinate reglets for masonry to locate horizontally into mortar joints.

3.6 GRAVEL STOPS

A. General:
1. Install gravel stops and fascias with allowance for expansion at each joint; minimum of 6 mm (1/4 inch).
2. Extend roof flange of gravel stop and splice plates not less than four inches out over roofing and nail or screw to wood nailers. Space fasteners on 75 mm (3 inch) centers in staggered pattern.
3. Install continuous cleat for fascia drip edge. Secure with fasteners as close to lower edge as possible on 75 mm (3 inch) centers.
4. Where ends of gravel stops and fascias abut a vertical wall, provide a watertight, flashed and sealant filled joint.
5. Set flange in roof cement when installed over built-up roofing.
6. Edge securement for low-slope roofs: Low-slope membrane roof systems metal edge securement, except gutters, shall be designed in accordance with ANSI/SPRI ES-1, except the basic wind speed shall be determined from Figure 1609, of IBC 2003.

B. Sheet metal gravel stops and fascia:
1. Install with end joints of splice plates sheets lapped three inches.
2. Hook the lower edge of fascia into a continuous edge strip.
3. Lock top section to bottom section for two piece fascia.

C. Corrugated sheet gravel stops and fascia:
1. Install 300 mm (12 inch) wide sheet flashing centered under joint. A combination bottom and cover plate, extending above and beneath the joint, may be used.
2. Hook lower edge of fascia into a continuous edge strip.

D. Scuppers:
1. Install scupper with flange behind gravel stops; leave 6 mm (1/4 inch) joint to gravel stop.
2. Set scupper at roof water line and fasten to wood blocking.
3. Use sealant to seal joint with fascia gravel stops at ends.
4. Coordinate to lap over conductor head and to discharge water into conductor head.

3.7 COPINGS

A. General:
1. On walls topped with a wood plank, install a continuous edge strip on the front and rear edge of the plank. Lock the coping to the edge strip with a 19 mm (3/4 inch) loose lock seam.
2. Where shown turn down roof side of coping and extend down over base flashing as specified for counter-flashing. Secure counter-flashing to lock strip in coping at continuous cleat.
3. Install ends adjoining existing construction so as to form space for installation of sealants. Sealant is specified in Section 07 92 00, JOINT SEALANTS.

B. Aluminum Coping:
1. Install with 6 mm (1/4 inch) joint between ends of coping sections.
2. Install joint covers, centered at each joint, and securely lock in place.

3.8 EXPANSION JOINT COVERS, INSULATED

A. Install insulated expansion joint covers at locations shown on curbs not less than 200 mm (8 inch) high above roof surface.

B. Install continuous edge strips of same metal as expansion joint flange, nailed at not less than 75 mm (3 inch) centers.

C. Install insulated expansion joint covers in accordance with manufacturer's directions locking edges to edge strips.

- - - E N D - - -

SECTION 07 81 00
APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Station Standard: CAFCO Blaze Shield II shall be used to replace and patch spray-applied fireproofing at the Minneapolis VAMC. No substitutions are approved for spray-applied fireproofing.

B. This section specifies spray-applied mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

1.2 RELATED WORK:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:
   1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Installer qualifications.

D. Testing laboratory accreditations.

E. Manufacturer's Literature and Data:
   1. Manufacturer's complete and detailed application instructions and specifications.
   2. Manufacturer's repair and patching instructions.

F. Certificates:
   1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.
      a. List thickness and density of material required to meet fire ratings.
      b. Accompanied by complete test report and test record.
   2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.

G. Miscellaneous:
   1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.
   2. Manufacturer's written approval of completed installation.
   3. Manufacturer's written approval of the applicators of fireproofing material.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver to job-site in sealed containers marked and labeled to show manufacturer's name and brand and UL certification markings of compliance with the specified requirements.

B. Remove damaged or opened containers from the site.

C. Store the materials off the ground, under cover, away from damp surfaces.

D. Keep dry until ready for use.

E. Remove materials that have been exposed to water before installation from the site.

1.5 FIELD CONDITIONS:

A. Temperature: Do not apply fireproofing when substrate or ambient temperature is below 4 degrees C (40 degrees F) unless temporary protection and heat are provided to maintain

temperature at or above stated value during application and for 24 hours before and after application.

B. Humidity: Maintain relative humidity levels within limits recommended by fireproofing manufacturer.

C. Ventilation: Provide ventilation to properly dry the fireproofing after application. Provide a minimum of four (4) air exchanges per hour by forced air circulation. When permitted by Contracting Officer Representative (COR), ventilate by natural circulation.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. Submit manufacturer's certification that each installer is trained and qualified to install the specified fireproofing. Submit evidence that each installer has a minimum of three (3) years' experience and a minimum of four (4) installations using the specified fireproofing.

B. Testing Laboratory Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority. Submit a copy of the Certificate of Accreditation and Scope of Accreditation.

C. Test for fire endurance in accordance with ASTM E119, for fire rating specified, in a nationally recognized laboratory.

D. Manufacturer's inspection and approval of surfaces to receive fireproofing.

E. Manufacturer's approval of fireproofing applications.

F. Manufacturer's approval of completed installation.

G. Manufacturer's representative is to observe and advise at the commencement of application, and is required to visit the site as required thereafter for the purpose of ascertaining proper application.

H. Pre-Application Test Area.
1. Apply a test area consisting of a typical overhead fireproofing installation, including not less than 4.5 m (15 feet) of beam and deck.
   a. Apply to one (1) column.
   b. Apply for the hourly ratings required in the construction documents.
2. Install in location selected by the COR, for approval by the representative of the fireproofing material manufacturer and the COR.
3. Perform Bond test for cohesive and adhesive strength in accordance with ASTM E736 for each applied fireproofing design used.
4. Perform density test in accordance with ASTM E736 for each applied fireproofing design used.
5. Do not proceed in other areas until installation of test area has been completed and approved.
6. Keep approved installation area open for observation as criteria for sprayed-on fireproofing.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):
C841-03(R2013) .....Installation of Interior Lathing and Furring

C847-14.....Metal Lath

E84-14.....Surface Burning Characteristics of Building Materials

E119-12a.....Fire Tests of Building Construction and Materials

E605-93(R2011).....Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members

E736-00(R2011).....Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

E759-92(R2011).....The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

E760-92(R2011).....Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members

E761-92(R2011).....Compressive Strength of Fire-Resistive Material Applied to Structural Members

E859-93(R2011).....Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members

E937-93(R2011).....Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members

E1042-02(R2014).....Acoustically, Absorptive Materials Applied by Trowel or Spray.

G21-13 .....Determining Resistance of Synthetic Polymeric Materials to Fungi

C. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory...Latest Edition including Supplements

D. Warnock Hersey (WH):
Certification Listings .....Latest Edition

E. Factory Mutual System (FM):
Approval Guide.....Latest Edition including Supplements

F. Environmental Protection Agency (EPA):
40 CFR 59(2014) .....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING:

A. Basis of Design: CAFCO Blaze Shield II shall be used to replace and patch spray-applied fireproofing at the Minneapolis VAMC.

B. ASTM E1042, Class (a), Category A.
1. Type I, factory mixed cementitious materials with approved aggregate.
2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 240 kg per cubic meter (15 lb. per cubic feet) density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.

C. Materials containing asbestos are not permitted.

D. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.

	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 3 m (10 ft.)

	Characteristic	Test	Results
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 9.57 kPa (200 lbf per sq. ft.) for protected areas. 19.15 kPa (400 lbf per sq. ft.) for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter 0.27 gm per sq. meter (0.025 gm per sq. ft.).

6.	Compressive Strength	ASTM E761	Minimum compressive strength 48 kPa (1000 psf).
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

2.2 ADHESIVE:

A. Bonding adhesive for Type II (fibrous) materials as recommended and supplied by the fireproofing material manufacturer.

B. Adhesive may be an integral part of the material or applied separately to surface receiving fireproofing material.

2.3 SEALER:

A. Sealer for Type II (fibrous) material as recommended and supplied by the fireproofing material manufacturer.

B. Surface burning characteristics as specified for fireproofing material.

C. Fungus resistant.

D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use contrasting color pigmented sealer, white preferred.

E. VOC content: Product to comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, (EPA Method 24):
1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

2.4 WATER:

A. Clean, fresh, and free from organic and mineral impurities.

B. pH of 6.9 to 7.1.

2.5 MECHANICAL BOND MATERIAL:

A. Expanded Metal Lath: ASTM C847, minimum weight of 0.92 kg per square meter (1.7 pounds per square yard) or as required, according to fire-resistance designs indicated and fire proofing manufacturer’s written instructions.

B. Fasteners: ASTM C841.

C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachments.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.

B. Verify hangers, inserts and clips are installed before the application of fireproofing material.

C. Verify ductwork, piping, and other obstructing material and equipment is not installed that will interfere with fireproofing installation.

D. Verify concrete work on steel decking and concrete encased steel is completed.

E. When applied in conjunction with roof structures or roof decks, verify that roofing, installation of rooftop HVAC equipment, and other related work are complete.

F. Verify temperature and enclosure conditions required by fire-proofing material manufacturer.

G. Conduct tests according to fireproofing manufacturer’s written instructions to verify that substrates are free of substances capable of interfering with bond. Submit test report.

3.2 APPLICATION:

A. Do not start application until written approval has been obtained from manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative, and are suitable to receive sprayed-on fireproofing.

B. Coordinate application of fireproofing material with other trades.

C. Cover other work and exterior openings subject to damage from fallout or overspray of fireproofing materials during application.

D. Application of Metal Lath:
   1. Apply to beam and columns having painted surfaces which fail ASTM E736 Bond Test requirements in pre-application test area.
   2. Apply to beam flanges 305 mm (12-inches) or more in width.
   3. Apply to column flanges 406 mm (16-inches) or more in width.
   4. Apply to beam or column web 406 mm (16-inches) or more in depth.
   5. Tack weld or mechanically fasten on maximum of 305 mm (12-inch) center.
   6. Lap and tie lath member in accordance with ASTM C841.

E. Mix and apply in accordance with manufacturer's instructions.
   1. Mechanically control material and water ratios.
   2. Apply adhesive and sealer, when not an integral part of the materials, in accordance with the manufacturer's instructions.
   3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test in accordance with ASTM E119.
   4. Minimum ASTM E605 applied dry density per cubic meter (cubic foot) for the underside of the walk on deck (interstitial) hung purlin or beam and steel deck, columns in interstitial spaces and mechanical equipment rooms to be as follows:
      a. Type I - 350 kg per cubic meter (22 lb. per cubic ft.).
      b. Type II - 240 kg per cubic meter (15 lb. per cubic ft.).

F. Complete application is to be completed in one area. Inspection and approval by COR is required before removal of application equipment and proceeding with further work.

3.3 FIELD TESTS:

A. The applied fireproofing to be tested by a COR approved independent testing laboratory and paid for by the Contractor. Submit test reports documenting results of tests on the applied material in the project.

B. COR will select area to be tested in specific bays on each floor using a geometric grid pattern. Apply test sample every 929 square meters (10,000 square feet) of floor area or two (2) for each floor, whichever produces the greatest number of test areas.

C. Test for thickness and density in accordance with ASTM E605. Areas showing thickness less than that required as a result of fire endurance test are not acceptable.

D. Areas showing less than required fireproofing characteristics are not suitable for the following field tests.
   1. Test for cohesion/adhesion: ASTM E736.
   2. Test for bond impact strength: ASTM E760.

3.4 PATCHING AND REPAIRING:

A. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.

B. Perform corrective measures in accordance with fireproofing material manufacturer's recommendations.
   1. Respray areas requiring additional fireproofing material to provide the required thickness, and replace dislodged or removed material.
   2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.
   3. Do not hand mix material.

C. Repair:
   1. Respray test and rejected areas.
   2. Patch fireproofing material which is removed or disturbed after approval.

D. Perform final inspection of sprayed areas after patching and repair.

3.5 SCHEDULE:

A. Apply fireproofing material in interior structural steel members and on underside of interior steel floor and roof decks, except on following surfaces:
   1. Structural steel and underside of steel decks in elevator or dumbwaiter machine rooms.
   2. Steel members in elevator hoist ways.
   3. Areas used as air handling plenums.
   4. Steel to be encased in concrete or designated to receive other type of fireproofing.

Fire Rating Schedule			
Type	Element	Hourly Rating	UL Design Reference
N/A	Columns supporting one floor	2	Existing
N/A	Columns supporting more than one floor (Continous thru Interstitial)	2	Existing
II	Columns supporting roof	1	X701
N/A	Floor decks (Service Bay)*	2	Existing
N/A	Floor supports (Service Bay)*	2	Existing
N/A	Floor decks (Function Floors)*	0	Existing
N/A	Floor supports (Function Floors)*	0	Existing
N/A	Interstitial decks	2	Existing
N/A	Interstitial supports	2	Existing
II	Roof decks	1	P710

Fire Rating Schedule			
Type	Element	Hourly Rating	UL Design Reference
II	Roof supports	1	P710

5. * Per VA Fire Protection Manual 7th Edition, December 2015 Section 2.3

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SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

B. Provide UL or equivalent approved firestopping system for the closure of openings in walls against penetration of gases or smoke in smoke partitions.

C. Pre-existing non-compliant penetrations, firestops, fire-caulking, fire and smoke rated partitions within the project area shall also be the responsibility of the Contractor to resolve as part of the project. In addition to sealing all new penetrations, Contractor is responsible for providing fire stopping for all existing, unprotected penetrations in the Area of Work.

1.2 RELATED WORK:

A. Sealants and application: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS:

Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

A. Installer qualifications.

B. Inspector qualifications.

C. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.

D. List of FM, UL, or WH classification number of systems installed.

E. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

F. Submit certificates from manufacturer attesting that firestopping materials comply with the specified requirements.

1.4 DELIVERY AND STORAGE:

A. Deliver materials in their original unopened containers with manufacturer’s name and product identification.

B. Store in a location providing protection from damage and exposure to the elements.

1.5 QUALITY ASSURANCE:

A. FM, UL, or WH or other approved laboratory tested products will be acceptable.

B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply with UL’s “Qualified Firestop Contractor Program Requirements.” Submit qualification data.

C. Inspector Qualifications: Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years’ experience in construction field inspections of firestopping systems, products, and assemblies. The inspector to be completely independent of, and divested from, the Contractor, the installer, the manufacturer, and the supplier of material or item being inspected. Submit inspector qualifications.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):
E84-14 ..... Surface Burning Characteristics of Building Materials
E699-09 ..... Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components
E814-13a ..... Fire Tests of Through-Penetration Fire Stops
E2174-14 ..... Standard Practice for On-Site Inspection of Installed Firestops
E2393-10a ..... Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

C. FM Global (FM):

D. Annual Issue Approval Guide Building Materials
4991-13 ..... Approval of Firestop Contractors

E. Underwriters Laboratories, Inc. (UL):

F. Annual Issue Building Materials Directory

G. Annual Issue Fire Resistance Directory
723-10(2008) ..... Standard for Test for Surface Burning Characteristics of Building Materials
1479-04(R2014) ..... Fire Tests of Through-Penetration Firestops

H. Intertek Testing Services - Warnock Hersey (ITS-WH):

I. Annual Issue Certification Listings

J. Environmental Protection Agency (EPA):
40 CFR 59(2014) ..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS:

A. Provide either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke. Firestop systems to accommodate building movements without impairing their integrity.

B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 101 mm (4 in.) nominal pipe or 0.01 sq. m (16 sq. in.) in overall cross sectional area.

C. Firestop sealants used for firestopping or smoke sealing to have the following properties:
1. Contain no flammable or toxic solvents.
2. Release no dangerous or flammable out gassing during the drying or curing of products.
3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

D. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials to have following properties:

1. Classified for use with the particular type of penetrating material used.
2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.

E. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.

F. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.

G. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and to not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.

H. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 101 mm (4 in.) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
4. Firestopping systems shall be Hilti or Approved Equal, red in color to easily identify it in the field.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS:

A. Provide silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.

B. Provide mineral fiber filler and bond breaker behind sealant.

C. Sealants to have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with ASTM E84.

D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

E. Smoke stopping systems shall **not be red in color** to easily distinguish it from Firestopping systems.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Submit product data and installation instructions, as required by article, submittals, after an on-site examination of areas to receive firestopping.

B. Examine substrates and conditions with installer present for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Remove dirt, grease, oil, laitance and form-release agents from concrete, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.

B. Remove insulation on insulated pipe for a distance of 150 mm (6 inches) on each side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

C. Prime substrates where required by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Apply masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 INSTALLATION:

A. Do not begin firestopping work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.

C. Provide engraved nameplate at each location identifying the firestopping system and system # for future documentation of the specific system installed.

D. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP:

A. As work on each floor is completed, remove materials, litter, and debris.

B. Clean up spills of liquid type materials.

C. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

D. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to provide firestopping complying with specified requirements.

3.5 INSPECTIONS AND ACCEPTANCE OF WORK:

A. Do not conceal or enclose firestop assemblies until inspection is complete and approved by the Contracting Officer Representative (COR).

B. Furnish service of approved inspector to inspect firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results. Submit written reports indicating locations of and types of penetrations and type of firestopping used at each location; type is to be recorded by UL listed printed numbers.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section covers interior and exterior sealant and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK (INCLUDING BUT NOT LIMITED TO THE FOLLOWING):

A. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.

B. Sound Rated Gypsum Partitions/Sound Sealants: Section 09 29 00, GYPSUM BOARD.

C. Mechanical Work: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer with a minimum of three (3) years' experience and who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance. Submit qualification.

B. Source Limitations: Obtain each type of joint sealant through one (1) source from a single manufacturer..
   1. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
   2. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
   3. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
   4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

C. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates 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. Locate test joints where indicated in construction documents as directed by COR.
   2. Conduct field tests for each application indicated below:
      a. Each type of elastomeric sealant and joint substrate indicated.
      b. Each type of non-elastomeric sealant and joint substrate indicated.
   3. Notify COR seven (7) days in advance of dates and times when test joints will be erected.

1.4 CERTIFICATION:

A. Contractor is to submit to the COR written certification that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vapor tight seals (as applicable), and that materials supplied meet specified performance requirements.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Installer qualifications.

C. Contractor certification.

D. Manufacturer's installation instructions for each product used.

E. Cured samples of exposed sealants for each color.

F. Manufacturer's Literature and Data:
1. Primers
2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

G. Manufacturer warranty.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations:
1. Do not proceed with installation of joint sealants under following conditions:
a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C (40 degrees F).
b. When joint substrates are wet.

B. Joint-Width Conditions:
1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:
1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 DELIVERY, HANDLING, AND STORAGE:

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures exceeding 32 degrees C (90 degrees F) or less than 5 degrees C (40 degrees F).

1.8 DEFINITIONS:

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Backing Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.9 WARRANTY:

A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".

B. Manufacturer Warranty: Manufacturer shall warranty their sealant for a minimum of five (5) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.10 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. ASTM International (ASTM):

C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material

C612-14.....Mineral Fiber Block and Board Thermal Insulation

C717-14a.....Standard Terminology of Building Seals and Sealants

C734-06(R2012) .....Test Method for Low-Temperature Flexibility of Latex Sealants after Artificial Weathering

C794-10.....Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

C919-12.....Use of Sealants in Acoustical Applications.

C920-14a.....Elastomeric Joint Sealants.

C1021-08(R2014) .....Laboratories Engaged in Testing of Building Sealants

C1193-13.....Standard Guide for Use of Joint Sealants.

C1248-08(R2012) .....Test Method for Staining of Porous Substrate by Joint Sealants

C1330-02(R2013) .....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants

C1521-13.....Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

D217-10.....Test Methods for Cone Penetration of Lubricating Grease

D412-06a(R2013) .....Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension

D1056-14.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

E84-09.....Surface Burning Characteristics of Building Materials

C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

D. Environmental Protection Agency (EPA):
40 CFR 59(2014) .....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SEALANTS:

A. Floor Joint Sealant:
1. ASTM C920, Type S or M, Grade P, Class 25, Use T. S-#2
2. S-#2 Provide location(s) of floor joint sealant as follows.
   a. Seats of metal thresholds exterior doors.
   b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

B. Interior Sealants:
1. S-#2 Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
2. Provide location(s) of interior sealant as follows:
   a. Typical narrow joint 6 mm, (1/4 inch) or less at walls and adjacent components.
   b. Perimeter of doors, windows, access panels which adjoin concrete or masonry surfaces.
   c. Interior surfaces of exterior wall penetrations.
   d. Joints at masonry walls and columns, piers, concrete walls or exterior walls.
   e. Perimeter of lead faced control windows and plaster or gypsum wallboard walls.
   f. Exposed isolation joints at top of full height walls.
   g. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplanar tile surfaces meet.
   h. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.
   i. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.

C. Acoustical Sealant:

1. Conforming to ASTM C919; flame spread of 25 or less; and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant have a consistency of 250 to 310 when tested in accordance with ASTM D217; remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734; and be non-staining.
2. Provide location(s) of acoustical sealant as follows:
   a. Exposed acoustical joint at sound rated partitions.
   b. Concealed acoustic joints at sound rated partitions.
   c. Joints where item pass-through sound rated partitions.

2.2 COLOR:

A. Sealants used with exposed masonry are to match color of mortar joints.

B. Sealants used with unpainted concrete are to match color of adjacent concrete.

C. Color of sealants for other locations to be light gray or aluminum, unless otherwise indicated in construction documents.

2.3 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
   1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056 or synthetic rubber (ASTM C509), nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32 degrees C (minus 26 degrees F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 FILLER:

A. Mineral fiberboard: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.5 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.6 CLEANERS-NON POROUS SURFACES:

A. Chemical cleaners compatible with sealant and acceptable to manufacturer of sealants and sealant backing material. Cleaners to be free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

B. Coordinate for repair and resolution of unsound substrate materials.

C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 3.2 PREPARATIONS:

A. Prepare joints in accordance with manufacturer's instructions and SWRI (The Professionals' Guide).

B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
   1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
   2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include but are not limited to the following:
      a. Concrete.
      b. Masonry.
      c. Unglazed surfaces of ceramic tile.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous surfaces include but are not limited to the following:
      a. Metal.
      b. Glass.
      c. Porcelain enamel.
      d. Glazed surfaces of ceramic tile.

C. Do not cut or damage joint edges.

D. Apply non-staining masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions or as indicated by pre-construction joint sealant substrate test.
   1. Apply primer prior to installation of back-up rod or bond breaker tape.
   2. Use brush or other approved means that will reach all parts of joints. Avoid application to or spillage onto adjacent substrate surfaces.

3.3 BACKING INSTALLATION:

A. Install backing material, to form joints enclosed on three sides as required for specified depth of sealant.

B. Where deep joints occur, install filler to fill space behind the backing rod and position the rod at proper depth.

C. Cut fillers installed by others to proper depth for installation of backing rod and sealants.

D. Install backing rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.

E. Where space for backing rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

3.4 SEALANT DEPTHS AND GEOMETRY:

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

A. General:
1. Apply sealants and caulking only when ambient temperature is between
2. 5 degrees C and 38 degrees C (40 degrees and 100 degrees F).
3. Do not install polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
4. Do not install sealant type listed by manufacture as not suitable for use in locations specified.
5. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
6. Avoid dropping or smearing compound on adjacent surfaces.
7. Fill joints solidly with compound and finish compound smooth.
8. Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C1193 unless shown or specified otherwise in construction documents. Remove masking tape immediately after tooling of sealant and before sealant face starts to “skin” over. Remove any excess sealant from adjacent surfaces of joint, leaving the working in a clean finished condition.
9. Finish paving or floor joints flush unless joint is otherwise detailed.
10. Apply compounds with nozzle size to fit joint width.
11. Test sealants for compatibility with each other and substrate. Use only compatible sealant. Submit test reports.
12. Replace sealant which is damaged during construction process.

B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise. Take all necessary steps to prevent three-sided adhesion of sealants.

C. Interior Sealants: Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cutouts to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
   1. Extent of Testing: Test completed elastomeric sealant joints as follows:
      a. Perform 10 tests for first 305 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.

B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

C. Inspect tested joints and report on following:
   1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
   2. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
   3. Whether sealants filled joint cavities and are free from voids.
   4. Whether sealant dimensions and configurations comply with specified requirements.

D. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

E. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING:

A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by manufacturer of the adjacent material or if not otherwise indicated by the caulking or sealant manufacturer.

B. Leave adjacent surfaces in a clean and unstained condition.

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hollow metal doors hung in hollow metal frames at interior locations.
2. Hollow metal door frames for wood doors and borrowed lights at interior locations.
3. Glazed openings in hollow metal doors.

1.2 RELATED REQUIREMENTS

A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.

B. Door Hardware: Section 08 71 00, DOOR HARDWARE.

C. Card Readers and Biometric Devices: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

D. Security Monitors: Section 28 23 00, VIDEO SURVEILLANCE.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standard Institute (ANSI):
A250.8-2014 - .....Standard Steel Doors and Frames.

C. ASTM International (ASTM):
A240/A240M-15b - .....Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

A653/A653M-15 - .....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip.

A1008/A1008M-15 - .....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

B209-14 - .....Aluminum and Aluminum-Alloy Sheet and Plate.

B209M-14 -..... Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

B221-14 - .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B221M-13 - .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

D3656/D3656M-13 - .....Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns.

E90-09 - .....Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

D. Federal Specifications (Fed. Spec.):
L-S-125B - .....Screening, Insect, Nonmetallic.

E. Master Painters Institute (MPI):
No. 18 - .....Primer, Zinc Rich, Organic.

F. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06 - .....Metal Finishes Manual.

G. National Fire Protection Association (NFPA):
80-16 - .....Fire Doors and Other Opening Protectives.

H. UL LLC (UL):
10C-09 - .....Positive Pressure Fire Tests of Door Assemblies.

1784-15 - .....Air Leakage Tests of Door Assemblies and Other Opening Protectives.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:
1. Description of each product.
2. Include schedule showing each door and frame requirements fire label and smoke control label for openings.
3. Installation instructions.

D. Sustainable Construction Submittals:
1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

E. Test reports: Certify each product complies with specifications.
1. Sound rated door.

F. Qualifications: Substantiate qualifications comply with specifications.
1. Manufacturer with project experience list.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Regularly manufactures specified products.
2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
   a. Project Experience List: Provide contact names and addresses for completed projects.

1.6 DELIVERY

A. Fasten temporary steel spreaders across the bottom of each door frame before shipment.

B. Deliver products in manufacturer's original sealed packaging.

C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.

B. Protect products from damage during handling and construction operations.

1.8 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design hollow metal doors and frames complying with specified performance:
   1. Fire Doors and Frames: UL 10C; NFPA 80 labeled.
      a. Fire Ratings: See drawings.
   2. Stair Doors: Temperature rise rated fire doors.
   3. Smoke Control Doors and Frames: UL 1784; NFPA 80 labeled, maximum 0.15424 cu. m/s/sq. m (3.0 cfm/sf) at 24.9 Pa (0.10 inches water gage) pressure differential.
   4. Sound Rated Doors and Frames: Minimum 45 sound transmission class (STC) when tested according to ASTM E90.

2.2 MATERIALS

A. Stainless Steel: ASTM A240/A240M; Type 304.

B. Sheet Steel: ASTM A1008/A1008M, cold-rolled.

C. Galvanized Sheet Steel: ASTM A653.

D. Insect Screening: ASTM D3656/D3656M, 18 by 18 aluminum wire mesh.

E. Aluminum Sheet: ASTM B209M (ASTM B209).

F. Aluminum Extrusions: ASTM B221M (ASTM B221).

2.3 PRODUCTS - GENERAL

A. Provide hollow metal doors and frames from one manufacturer.

B. Sustainable Construction Requirements:
   1. Steel Recycled Content: 30 percent total recycled content, minimum.
   2. Stainless Steel Recycled Content: 70 percent total recycled content, minimum.
   3. Aluminum Recycled Content: 80 percent total recycled content, minimum.

2.4 HOLLOW METAL FRAMES

A. Hollow Metal Frames: ANSI A250.8; face welded. See drawings for sizes and designs.
   1. Interior Frames:
      a. Wood Doors and Borrowed Lights:1.0 mm (0.042 inch) thick.
   2. Interior Borrowed Light Frames: 1.3 mm (0.051 inch) thick.

B. Frame Materials:
   1. Interior Frames: Sheet steel Z120 or ZF120 (G40 or A40) coating.

2.5 FABRICATION

A. Hardware Preparation: ANSI A250.8; for hardware specified in Section 08 71 00, DOOR HARDWARE.

B. Hollow Metal Door Fabrication:
   1. Close top edge of exterior doors flush and seal to prevent water intrusion.
   2. Fill spaces between vertical steel stiffeners with insulation.

C. Fire and Smoke Control Doors:
   1. Close top and vertical edges flush.
   2. Apply steel astragal to active leaf at pair and double egress doors.
      a. Exception: Where vertical rod exit devices are specified for both leaves swinging in same direction.
   3. Fire and Smoke Control Door Clearances: NFPA 80.

D. Sound Rated Doors:
   1. Seals: Integral spring type automatic door bottom seal.

2. Fabricate vision panel cutouts and frames to receive double glazing as shown on drawings.

E. Detention Doors:
1. Vision panels:
   a. Weld 3 mm (1/8 inch) thick steel channel reinforcements around cut-outs in doors to accommodate vision lights.
   b. Fabricate glazing stops on room side of doors, of 3 mm (1/8 inch) thick steel sheets mitered and welded at corners, and continuously welded both sides into doors.
   c. Fabricate glazing bead for corridor side of doors of 9 mm (3/8 inch) by 19 mm (3/4 inch) steel bar, miter and weld at the corners, and fasten to doors with 6 mm (1/4 inch) countersunk screws near corners and centers of both sides of opening.
      1) Back-up screw holes with 3 mm (1/8 inch) thick reinforcements or weld nuts to back of frames to receive screws.
   d. Size rabbet for safety glass and glazing cushions specified.

F. Transom Panel Fabrication:
1. Fabricate panels as specified for doors.
2. Fabricate bottom edge with rabbet stop where no transom bar occurs.

G. Hollow Metal Frame Fabrication:
1. Fasten mortar guards to back of hardware reinforcements, except on lead-lined frames.
2. Concealed Closers in Head Frame: Provide 1 mm (0.042 inch) thick steel removable stop sections for access to concealed face plates and control valves, except when cover plates are furnished with closer.
3. Terminated Stops: ANSI A250.8.
4. Borrowed Light Frames:
   a. Provide integral stop on exterior, corridor, or secure side of door.
   b. Design rabbet width and depth to receive glazing material or panel shown on drawings.
5. Frame Anchors:
   a. Floor anchors:
      1) Provide extension type floor anchors to compensate for depth of floor fills.
      2) Provide 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive floor fasteners.
      3) Provide 50 mm by 50 mm by 9 mm (2 inch by 2 inch by 3/8 inch) clip angle for lead lined frames, drilled for floor fasteners.
      4) Provide mullion 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two floor fasteners and frame anchor screws.
      5) Provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for floor fasteners and frame anchor screws for sill sections.
         a) Space floor bolts50 mm (24 inches) on center.
   b. Jamb anchors:
      1) Place anchors on jambs:
         a) Near top and bottom of each frame.
         b) At intermediate points at maximum 600 mm (24 inches) spacing.
      2) Form jamb anchors from steel minimum 1 mm (0.042 inch) thick.
      3) Anchors set in masonry: Provide adjustable anchors designed for friction fit against frame and extended into masonry minimum 250 mm (10 inches). Provide one of following types:
         a) Wire Loop Type: 5 mm (3/16 inch) diameter wire.
         b) T-Shape type.
         c) Strap and stirrup type: Corrugated or perforated sheet steel.
      4) Anchors for stud partitions: Provide tabs for securing anchor to sides of studs. Provide one of the following:
         a) Welded type.

b) Lock-in snap-in type.

5) Anchors for frames set in prepared openings:
   a) Steel pipe spacers 6 mm (1/4 inch) inside diameter, welded to plate reinforcing at jamb stops, or hat shaped formed strap spacers 50 mm (2 inches) wide, welded to jamb near stop.
   b) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass through frame and spacers.
   c) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
6) Anchors for observation windows and other continuous frames set in stud partitions.
   a) Weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
   b) Space maximum 600 mm (24 inches) on centers.
7) Modify frame anchors to fit special frame and wall construction.
8) Provide special anchors where shown on drawings and where required to suit application.

H. Sound Rated Door Frames:
   1. Seals: Integral continuous gaskets on frames.

2.6 FINISHES

A. Steel: ANSI A250.8; shop primed.

B. Stainless Steel: NAAMM AMP 500; No. 4 polished finish.
   1. Blend welds to match adjacent finish.

C. Finish exposed surfaces after fabrication.

D. Aluminum Anodized Finish: NAAMM AMP 500.
   1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
   2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.
   3. Clear Anodized Finish: AA-C22A31; Class II Architectural, 0.01 mm (0.4 mil) thick.
   4. Color Anodized Finish: AA-C22A32 or AA-C22A34; Class II Architectural, 0.01 mm (0.4 mil) thick.

2.7 ACCESSORIES

A. Primers: ANSI A250.8.

B. Barrier Coating: ASTM D1187/D1187M.

C. Welding Materials: AWS D1.1/D1.1M, type to suit application.

D. Clips Connecting Members and Sleeves: Match door faces.

E. Fasteners: stainless steel.
   1. Metal Framing: Steel drill screws.
   2. Masonry and Concrete: Expansion bolts and power actuated drive pins.

F. Anchors: stainless steel.

G. Galvanizing Repair Paint: MPI No. 18.

H. Insulation: Unfaced mineral wool.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Apply barrier coating to metal surfaces in contact with cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
   2. Install fire doors and frames according to NFPA 80.
   3. Install smoke control doors and frames according to NFPA 105.

3.3 FRAME INSTALLATION

A. Apply barrier coating to concealed surfaces of frames built into masonry.

B. Plumb, align, and brace frames until permanent anchors are set.
   1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
   2. Use wood spreaders at bottom of frame when shipping spreader is removed.
   3. Where construction permits concealment, leave shipping spreaders in place after installation, otherwise remove spreaders when frames are set and anchored.
   4. Remove wood spreaders and braces when walls are built and jamb anchors are secured.

C. Floor Anchors:
   1. Anchor frame jambs to floor with two expansion bolts.
      a. Lead Lined Frames: Use 9 mm (3/8 inch) diameter bolts.
      b. Other Frames: Use 6 mm (1/4 inch) diameter bolts.
   2. Power actuated drive pins are acceptable to secure frame anchors to concrete floors.

D. Jamb Anchors:
   1. Masonry Walls:
      a. Embed anchors in mortar.
      b. Fill space between frame and masonry with grout or mortar as walls are built.
   2. Metal Framed Walls: Secure anchors to sides of studs with two fasteners through anchor tabs.
   3. Fill all HM door jambs with grout after applying a bituminous coating to the inside of the frame.
   4. Prepared Masonry and Concrete Openings:
      a. Direct Securement: 6 mm (1/4 inch) diameter expansion bolts through spacers.
      b. Subframe or Rough Buck Securement:
         1) 6 mm (1/4 inch) diameter expansion bolts on 600 mm (24 inch) centers.
         2) Power activated drive pins on 600 mm (24 inches) centers.
      c. Secure two-piece frames to subframe or rough buck with machine screws on both faces.

E. Frames for Sound Rated Doors: Fill frames with insulation.

F. Touch up damaged factory finishes.
   1. Repair galvanized surfaces with galvanized repair paint.
   2. Repair painted surfaces with touch up primer.

3.4 DOOR INSTALLATION

A. Install doors plumb and level.

B. Adjust doors for smooth operation.

C. Touch up damaged factory finishes.
   1. Repair galvanized surfaces with galvanized repair paint.
   2. Repair painted surfaces with touch up primer.

3.5 CLEANING

A. Clean exposed door and frame surfaces. Remove contaminants and stains.

3.6 PROTECTION

A. Protect doors and frames from construction operations.

B. Remove protective materials immediately before acceptance.

C. Repair damage.

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SECTION 08 14 00

INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior flush wood doors transparent finish.
   a. Fire rated doors.
   b. Smoke rated doors.
   c. Acoustical doors.
2. Interior stile and rail wood doors transparent finish.

1.2 RELATED REQUIREMENTS

A. Door Hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.

B. Installation of Doors and Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 71 00, DOOR HARDWARE.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA):
1. I.S. 1A-13 - Architectural Wood Flush Doors.
2. I.S. 6A-13 - Interior Architectural Stile and Rails Doors.

C. ASTM International (ASTM):
1. E90-09 - Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions and Elements.

D. National Fire Protection Association (NFPA):
1. 80-16 - Fire Doors and Other Opening Protectives.
2. 252-12 - Fire Tests of Door Assemblies.

E. UL LLC (UL):
1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.

F. Window and Door Manufacturers Association (WDMA):
1. TM 7-14 - Cycle-Slam Test.
2. TM 8-14 - Hinge Loading Test.
3. TM 10-14 - Screw Holding Capacity.

1.4 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.
2. Include details of glazing louvers.
3. Indicate project specific requirements not included in Manufacturer's Literature and Data submittal.

C. Manufacturer's Literature and Data:
1. Description of each product.
2. Fire rated doors showing conformance with NFPA 80.

D. Sustainable Construction Submittals:

1. Low Pollutant-Emitting Materials:
    a. Show volatile organic compound types and quantities.

E. Test Reports: Indicate each product complies with specifications.
1. Screw Holding Capacity Test.
2. Cycle-Slam Test.
3. Hinge-Loading Test.

F. Operation and Maintenance Data:
1. Care instructions for each exposed finish product.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Regularly and presently manufactures specified products.
2. Manufactures specified products with satisfactory service on five similar installations for minimum five years.

1.6 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.
1. Minimum 0.15 mm (6 mil) polyethylene bags or cardboard packaging to remain unbroken during delivery and storage.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, and manufacture date.
1. Identify door opening corresponding to Door Schedule.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.
1. Store doors according to ANSI/WDMA I.S. 1A.

B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:
1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.
    a. Comply with door manufacturer's instructions for relative humidity.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

B. Manufacturer's Warranty: Warrant interior factory finished flush wood doors against material and manufacturing defects.
1. Warranty Period: Lifetime of original installation.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

A. Basis of Design: See Construction Documents.

B. Provide each product from one manufacturer.

2.2 FLUSH WOOD DOORS

A. General:
1. ANSI/WDMA I.S. 1A, Extra Heavy Duty.
2. Adhesive: Type II.
3. Core: Structural composite lumber, except when mineral core is required for fire rating.
4. Thickness: 35 mm (1-3/8 inch) unless otherwise shown or specified.

B. Faces:
1. ANSI/WDMA I.S. 1A.
2. Wood door species shall be verified by contractor to match adjacent species type of doors in the area. Typically, these doors are, Oak veneer with a solid core, or a solid core door.
3. Transparent Finished Faces: Premium Grade. plane sliced
   a. face veneer.
   b. Match face veneers for doors for uniform effect of color and grain at joints.
   c. Door Edges: Same species as door face veneer.
   d. In existing buildings, where doors are required to have transparent finish, use wood species, grade, and assembly of face veneers to match adjacent existing doors.
4. Painted Finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay.
5. Factory finish all doors. Field finishing is not-allowable.

C. Wood For Stops, Louvers, Muntins and Moldings For Flush Doors Required to Have Transparent Finish:
1. Solid wood of same species as face veneer.
2. Glazing:
   a. On non-fire-rated doors, use applied wood stops nailed tightly on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 125 mm (5 inches) on center.
3. Wood Louvers:
   a. Door manufacturer's standard product, fabricated of solid wood sections.
   b. Wood Slats: minimum 5 mm (3/16 inch) thick.
   c. Stiles routed out to receive slats.
   d. Secure louvers in prepared cutouts with wood stops.

D. Stiles and Rails:
1. Composite material having screw withdrawal force greater than minimum performance level value when tested according to WDMA TM 10.
2. Provide adequate blocking for bottom of doors having mechanically operated door bottom seal meeting or exceeding performance duty level per WDMA TM 10 for horizontal door edge screw holding.
3. Rabbeted transom meeting rail edges match face veneers of doors. Bottom rail of transom panel match face veneer on non-rabbeted meeting rail edge.

E. Fire-Rated Wood Doors:
1. Fire Resistance Rating:
   a. B Label: 1-1/2 hours.
   b. C Label: 3/4 hour.
2. Labels:
   a. Comply with NFPA 252, UL 10C, and labeled by qualified testing and inspection agency showing fire resistance rating.
   b. Metal labels with raised or incised markings.
3. Performance Criteria for Stiles of Doors Utilizing Standard Mortise Leaf Hinges:
   a. Hinge Loading: WDMA TM 8. Average of 10 test samples for Extra Heavy Duty doors.

b. Direct Screw Withdrawal: WDMA TM 10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.
c. Cycle-Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested according to WDMA TM 7.

4. Hardware Reinforcement:
   a. Provide fire and smoke rated doors with hardware reinforcement blocking.
   b. Size of lock blocks as required to secure hardware specified.
   c. Top, Bottom and Intermediate Rail Blocks: Minimum 125 mm (5 inches) by full core width.
   d. Reinforcement blocking in compliance with labeling requirements.
   e. Mineral material similar to core is not acceptable.
5. Other Core Components: Manufacturer's standard as allowed by labeling requirements.
6. Glazed Vision Panel Frame: Steel approved for use in labeled doors.
7. Astragal: Steel type for pairs of doors.

F. Smoke Barrier Doors:
1. Glazed Vision Panel Frame: Steel approved for use in labeled doors.
2. Astragal: Steel type for pairs of doors, including double egress doors.

G. Sound Rated Doors:
1. Fabricated as specified for flush wood doors with additional construction requirements to comply with specified sound transmission class (STC).
2. STC Rating of door assembly in place when tested according to ASTM E90 by independent acoustical testing laboratory minimum 40.
3. Accessories:
   a. Frame Gaskets and Automatic Door Bottom Seal: As specified in Section 08 71 00, DOOR HARDWARE.

H. Dutch Doors:
1. Consist of two sections, each fabricated as specified for flush doors.
2. Construct shelf as detailed, from clear hardwood stock of same species as face veneer of door.
3. Place shelf on top of lower section of door and support as shown with a pair of wood or wrought steel brackets.
4. Prime steel brackets for finish painting.

2.3 STILE AND RAIL WOOD DOORS

A. Doors: ANSI/WDMA I.S. 6A; Grade Premium, size and design shown on drawings.

B. Species: Wood door species shall be verified by contractor to match adjacent species type of doors in the area. Typically, these doors are, Birch or Oak veneer with a solid core, or a solid core door with a plastic laminate (IPC) on both sides.

C. Door Panels:
1. Grain of face of panels parallel with longest dimensions of panel.
2. Flat panels: Veneered composite core, minimum 16 mm (5/8 inch) thick.
3. Raised panels: Unless otherwise shown, thickness of raised panels minimum the following:
   a. For 35 mm (1-3/8 inch) and 44 mm (1-3/4 inch) thick doors: 28 mm (1-1/8 inch) thick.
4. Where armor plate is required for paneled doors, provide panels with plywood fillers, glued in place, and finished.

D. Stops and Molds:
1. Solid sticking both sides, same material as stiles and rails, coped joints.
2. Glazed Vision Panel Frame: Applied wood stops nailed on interior side of door.

E. Louvers: Size as shown.

2.4 FABRICATION

A. Factory machine interior wood doors to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.
   1. Factory fit fire rated doors according to NFPA 80.

B. Rout doors for hardware using templates and location heights specified in Section 08 71 00, DOOR HARDWARE.

C. Factory fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness.

D. Clearances between Doors and Frames and Floors:
   1. Fire Rated Doors: Comply with NFPA 80.
      a. Doors with Automatic Bottom Seal: Maximum clearance 10 mm (3/8 inch) at threshold.
      b. Other Door Bottoms: Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
   2. Door Jambs, Heads, and Meeting Stiles: Maximum 3 mm (1/8 inch).

E. Provide cutouts for glazed openings.

F. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.

G. Identify each door on top edge.
   1. Mark with stamp, brand or other indelible mark, giving manufacturer’s name, door’s trade name, construction of door, date of manufacture and quality.
   2. Mark door or provide separate certification including name of inspection organization.
   3. Identify door manufacturing standard, including glue type.
   4. Identify veneer and quality certification.
   5. Identification of preservative treatment for stile and rail doors.

2.5 FINISHES

A. Field Finished Doors: Seal top and bottom edges of doors with two coats of catalyzed polyurethane or water resistant sealer.

B. Factory Transparent Finish:
   1. Factory finish flush wood doors.
      a. ANSI/WDMA I.S. 1A Section F-3 Finish System Descriptions for System 5, Conversion Varnish or System 7, Catalyzed Vinyl.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.
   1. Verify door frames are properly anchored.
   2. Verify door frames are plumb, square, in plane, and within tolerances for door installation.

B. Protect existing construction and completed work from damage.

C. Install astragal on active leaf of pair of smoke doors and one leaf of double egress smoke doors.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions and approved submittal drawings.
   1. Install fire rated doors according to NFPA 80.
   2. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.3 PROTECTION

A. After installation, place shipping container over door and tape in place.
   1. Do not apply tape to door faces and edges.

B. Provide protective covering over exposed hardware in addition to covering door.

C. Maintain covering in good condition until removal is directed by Contracting Officer's Representative.

- - E N D - -

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

A. Caulking: Section 07 92 00 JOINT SEALANTS.

B. Application of Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES

C. Painting: Section 09 91 00, PAINTING.

D. Card Readers: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS.

E. Electrical: Division 26, ELECTRICAL.

1.3 GENERAL

A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.

B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).

C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.

D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.

E. The following items shall be of the same manufacturer, except as otherwise specified:
1. Mortise locksets.
2. Hinges for hollow metal and wood doors.
3. Surface applied overhead door closers.
4. Exit devices.
5. Floor closers.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
1. Locks, latchsets, and panic hardware: 5 years.
2. Door closers and continuous hinges: 10 years.

1.5 MAINTENANCE MANUALS

A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:
1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

1.7 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to Resident Engineer for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in Resident Engineer's office until all other similar items have been installed in project, at which time the Resident Engineer will deliver items on file to Contractor for installation in predetermined locations on the project.

1.8 PREINSTALLATION MEETING

A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer’s Representative. Review the following:
1. Inspection of door hardware.
2. Job and surface readiness.
3. Coordination with other work.
4. Protection of hardware surfaces.
5. Substrate surface protection.
6. Installation.
7. Adjusting.
8. Repair.
9. Field quality control.
10. Cleaning.

1.9 INSTRUCTIONS

A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.

B. Keying: All cylinders shall be keyed into existing Grand Master Key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the Resident Engineer.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.

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

F883-04 ..... Padlocks

E2180-07 ..... Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials

C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

A156.1-06 ..... Butts and Hinges

A156.2-03 ..... Bored and Pre-assembled Locks and Latches

A156.3-08 ..... Exit Devices, Coordinators, and Auto Flush Bolts

A156.4-08 ..... Door Controls (Closers)

A156.5-14 ..... Cylinders and Input Devices for Locks.

A156.6-05 ..... Architectural Door Trim

A156.8-05 ..... Door Controls-Overhead Stops and Holders

A156.11-14 ..... Cabinet Locks

A156.12-05 ..... Interconnected Locks and Latches

A156.13-05 ..... Mortise Locks and Latches Series 1000

A156.14-07 ..... Sliding and Folding Door Hardware

A156.15-06 ..... Release Devices-Closer Holder, Electromagnetic and Electromechanical

A156.16-08 ..... Auxiliary Hardware

A156.17-04 ..... Self-Closing Hinges and Pivots

A156.18-06 ..... Materials and Finishes

A156.20-06 ..... Strap and Tee Hinges, and Hasps

A156.21-09 ..... Thresholds

A156.22-05 ..... Door Gasketing and Edge Seal Systems

A156.23-04 ..... Electromagnetic Locks

A156.24-03.....Delayed Egress Locking Systems

A156.25-07 .....Electrified Locking Devices

A156.26-06.....Continuous Hinges

A156.28-07 .....Master Keying Systems

A156.29-07 .....Exit Locks and Alarms

A156.30-03 .....High Security Cylinders

A156.31-07 .....Electric Strikes and Frame Mounted Actuators

A156.36-10.....Auxiliary Locks

A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):
80-10 .....Fire Doors and Other Opening Protectives

101-09 .....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):
Building Materials Directory (2008)

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Store Room Lock
1. SARGENT – ASSA ABLOY, or approved equal.

B. Office Entrance Lock
1. SARGENT – ASSA ABLOY, or approved equal.

C. Bathroom Lock
1. SARGENT – ASSA ABLOY, or approved equal.

D. Entrance Lock
1. SARGENT – ASSA ABLOY, or approved equal.

2.2 BUTT HINGES

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:
1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.
2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:
1. Doors up to 1210 mm (4 feet) high: 2 hinges.
2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.

5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
7. Provide heavy-weight hinges where specified.
   a. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.3 CONTINUOUS HINGES

A. ANSI/BHMA A156.26, Grade 1-600.
   1. Listed under Category N in BHMA's "Certified Product Directory."

B. General: 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

C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35mm (0.25-inch) minimum diameter pin that extends entire length of hinge.
   1. Base Metal for Exterior Hinges: Stainless steel.
   2. Base Metal for Interior Hinges: Stainless steel.
   3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel.
   4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
   5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
   6. Provide with manufacturer’s cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
   7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
   8. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer’s adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

2.4 DOOR CLOSING DEVICES

A. Closing devices shall LCN to match existing hospital stock.

2.5 OVERHEAD CLOSERS

A. Conform to ANSI A156.4, Grade 1.

B. Closers shall conform to the following:
   1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
   2. Where specified, closer shall have hold-open feature.
   3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
   4. Material of closer body shall be forged or cast.
   5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
   6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
   7. Closers shall have full size metal cover; plastic covers will not be accepted.
   8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
   9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth

screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.

10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

2.6 FLOOR CLOSERS AND FLOOR PIVOT SETS

A. Comply with ANSI A156.4. Provide stainless steel floor plates for floor closers and floor pivots, except where metal thresholds occur. Provide cement case for all floor closers. Floor closers specified for fire doors shall comply with Underwriters Laboratories, Inc., requirements for concealed type floor closers for classes of fire doors indicated on drawings. Hold-open mechanism, where required, shall engage when door is opened 105 degrees, except when door swing is limited by building construction or equipment, the hold-open feature shall engage when door is opened approximately 90 degrees. The hold-open mechanism shall be selectable on/off by turning a screw through the floor plate. Floor closers shall have adjustable hydraulic back-check, adjustable close speed, and adjustable latch speed. Provide closers with delayed action where a hold-open mechanism is not required. Floor closers shall be multi-sized. Single acting floor closers shall also have built in dead stop. Where required, provide closers with special cement cases appropriate for shallow deck installation or where concrete joint lines run through the floor blockout. At offset-hung doors installed in deep reveals, provide special closer arm and spindle to allow for installation. Where stone or terrazzo is applied over the floor closer case, provide closer without floor plate and with extended spindle (length as required) and special cover pan (depth as required) to allow closer to be accessed without damaging the material applied over the closer. Pivots for non-labeled doors shall be cast, forged or extruded brass or bronze.

B. Where floor closer appears in hardware set provide the following as applicable.
   1. Double Acting Floor Closers: Type C06012.
   2. Single Acting Floor Closer: Type C06021 (center pivoted). (Intermediate pivot is not required).
   3. Single Acting Floor Closers: Type C06041 (offset pivoted).
   4. Single Acting Floor Closer for Labeled Fire Doors: Type C06051 (offset pivoted).
   5. Single Acting Floor Closers For Lead Lined Doors: Type C06071 (offset pivoted).

2.7 DOOR STOPS

A. Conform to ANSI A156.16.

B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.

C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.

D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.

E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.

F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.

G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.

H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.

I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.

J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.

K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.

L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.8 OVERHEAD DOOR STOPS AND HOLDERS

A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

2.9 FLOOR DOOR HOLDERS

A. Conform to ANSI Standard A156.16. Provide extension strikes for Types L01301 and L01311 holders where necessary.

2.10 LOCKS AND LATCHES

A. "Sargent" ASSA Abloy w/Medeco 4X Large Format 6 pin removeable/interchangeable cores to match existing hospital lock/security system hardware, or approved equal.

B. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pins. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.

C. In addition to above requirements, locks and latches shall comply with following requirements:

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless

steel. Provide sectional (lever x rose) lever design matching existing. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.

2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)
3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.36.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.
5. Privacy locks in non-mental-health patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

2.11 ELECTROMAGNETIC LOCKS

A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
   1. Type: Full exterior or full interior, as required by application indicated.
   2. Strength Ranking: 500 lbf (2224 N).
   3. Inductive Kickback Peak Voltage: Not more than 0V.
   4. Residual Magnetism: Not more than 4 lbf (18 N) to separate door from magnet.

B. Delayed-Egress Locks: BHMA A156.24.
   1. Means of Egress Doors: Lock releases within 15 seconds after applying a force not more than 15 lbf (67 N) for not more than 3 seconds, as required by NFPA 101.
   2. Security Grade: Activated from secure side of door by initiating device.
   3. Movement Grade: Activated by door movement as initiating device.
   4. The lock housing shall not project more than 4-inches (101mm) from the underside of the frame head stop.

2.12 ELECTRIC STRIKES

A. ANSI/ BHMA A156.31 Grade 1.

B. General: Use fail-secure electric strikes at fire-rated doors.

2.13 KEYS

A. Key shall be Medeco (hospital's existing keying system), X4 Large Format with Interchangeable/Removeable cores, contractor shall provide sequential serial numbers on each key, VA shall provide additional keying information during submittals.

B. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	Quantity
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

C. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

2.14 KEY CABINET

A. ANSI Standard A156.11. Provide key cabinet made of cold rolled, 1.2 mm (0.0478 inch) thick furniture steel electro-welded. Doors shall have "no sag" continuous brass-pin piano type hinge and be equipped with chrome plated locking door handles, hook cam and mechanical pushbutton door lock. Key Cabinet and Key Control System shall accommodate all keys for this project plus 25 percent. Provide minimum number of multiple cabinets where a single cabinet of largest size will not accommodate the required number of keys.

B. Key tags shall consist of two sets: Permanent self-locking and loan key snaphook type with tag colors as follows: Red fiber marker of the permanent self-locking type approximately 32 mm (1-1/4 inch) in diameter engraved with the legend "FILE KEY MUST NOT BE LOANED." Also furnish for each hook a white cloverleaf key marker with snap-hooks engraved with the legend "LOAN KEY."

C. The manufacturer of the lock cylinders and locks shall attach a key tag to keys of each lock cylinder and shall mark thereon the respective item number and key change number. Provide each group of keys in a key gathering envelope (supplied by Key Cabinet Manufacturer) in which the lock manufacturer shall include the following information: Item number, key change number and door number. The contractor shall furnish the Key Cabinet Manufacturer the hardware and keying schedules and change keys.

D. The Key Cabinet Manufacturer shall set up a three-way cross index system, including master keys, listing the keys alphabetically, the hooks numerically and the key changes numerically on different colored index cards. Index cards shall be typewritten and inserted in a durable binder. Attach the keys to the two sets of numbered tags supplied with the cabinet. (The permanent tag and the loan key tag). Instruct the owner in proper use of the system. Install cabinet as directed by the Resident Engineer.

2.15 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING

A. Conform to ANSI Standard A156.6.

B. Provide protective plates and door edging as specified below:
   1. Kick plates, mop plates and armor plates of metal, Type J100 series.
   2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
   3. Kick plates and/or mop plates are not required on following door sides:
      a. Armor plate side of doors;
      b. Exterior side of exterior doors;

c. Closet side of closet doors;
d. Both sides of aluminum entrance doors.

4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.16 EXIT DEVICES

A. Basis of Design: Von Duprin

B. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.

C. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.

D. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.

E. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.

F. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.

G. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

2.17 FLUSH BOLTS (LEVER EXTENSION)

A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.

B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.

C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).

D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.

E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

2.18 FLUSH BOLTS (AUTOMATIC)

A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).

B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.19 DOOR PULLS WITH PLATES

A. Conform to ANSI A156.6. Pull Type J401, 152 mm CTC (6 inches CTC) length by 19 mm (3/4 inches) diameter minimum with plate Type J302, 90 mm by 381 mm (3-1/2 inches by 15 inches), unless otherwise specified. Provide pull with projection of 57.2 mm (2 1/4 inches) minimum and a clearance of 38.1 mm (1 1/2 inches) minimum. Cut plates of door pull plate for cylinders, or turn pieces where required.

2.20 PUSH PLATES

A. Conform to ANSI A156.6. Metal, Type J302, 203 mm (8 inches) wide by 406.4 mm (16 inches) high. Provide metal Type J302 plates 102 mm (4 inches) wide by 406.4 mm (16 inches) high where push plates are specified for doors with stiles less than 203 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

2.21 COMBINATION PUSH AND PULL PLATES

A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high), top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

2.22 COORDINATORS

A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

2.23 THRESHOLDS

A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.

B. For thresholds at elevators entrances see other sections of specifications.

C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.

D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) beyond face of frame.

2.24 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET FOR LIGHT PROOF OR SOUND CONTROL DOORS

A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

2.25 WEATHERSTRIPS (FOR EXTERIOR DOORS)

A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length (0.000774m^3/s/m).

2.26 MISCELLANEOUS HARDWARE

A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E07213, conforming to ANSI A156.11. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.

B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur, except as otherwise specified. Provide cylinders to operate locking devices where specified for following partitions and doors:
1. Folding doors and partitions.
2. Wicket door (in roll-up door assemblies).
3. Slide-up doors.
4. Swing-up doors.
5. Fire-rated access doors-Engineer's key set.
6. Doors from corridor to electromagnetic shielded room.
7. Day gate on vault door.

C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

2.27 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES

A. ASTM E883, size 50 mm (2 inch) wide chain; furnish extended shackles as required by job conditions. Provide padlocks, with key cylinders, for each door in following areas as noted.

B. Key padlocks as follows:
1. Constant Temperature and Cold Rooms

C. Omit padlocks on communicating refrigerator doors.

2.28 THERMOSTATIC TEMPERATURE CONTROL VALVE CABINETS

A. Where lock is shown, equip each cabinet door (metal) with lock Type E06213, conforming to ANSI A156.36. Key locks in Key Sets approved by Contracting Officer. See mechanical drawings and specifications for location of cabinets.

B. Cabinet manufacturer shall supply the hinges, bolts and pulls. Ship locks to cabinet manufacturer for installation.

2.29 HINGED WIRE GUARDS (FOR WINDOWS, DOORS AND TRANSOMS) AND WIRE PARTITION DOORS

A. Butt hinges, type A8133 (special swaging) 100 mm by 90 mm (4 inches by 3-1/2 inches), Finish US2C.
1. 3 hinges for guards over 1060 mm (3-1/2 feet) high.
2. 2 hinges for guards less than 1060 mm (3-1/2 feet) high.

B. Conform to ANSI A156.36. Lock Type E06081 for guards and Type E06061 for partitions.

1. Keying: Except as noted otherwise, key locks like entrance door or space wherein guards and partitions are located except as otherwise specified.
2. Key locks for partitions enclosing mechanical and electrical equipment in Engineer's Set. (See detailed drawings for number of locks and butt hinges required for each guard).

2.30 FINISHES

A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.

B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.

C. Miscellaneous Finishes:
1. Hinges --exterior doors: 626 or 630.
2. Hinges --interior doors: 652 or 630.
3. Pivots: Match door trim.
4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
5. Thresholds: Mill finish aluminum.
6. Cover plates for floor hinges and pivots: 630.
7. Other primed steel hardware: 600.

D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.

E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.

2.31 BASE METALS

A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	Base Metal
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to VA Resident Engineer for approval.

B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
3. Deadlocks centerline of strike 1219 mm (48 inches).
4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
5. Centerline of door pulls to be 1016 mm (40 inches).
6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors.. At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.

B. Hinge Size Requirements:

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by Resident Engineer. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of Resident Engineer that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the Resident Engineer for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 FINAL INSPECTION

A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:
   1. Re-adjust hardware.

2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
3. Identify items that have deteriorated or failed.
4. Submit written report identifying problems.

3.4 DEMONSTRATION

A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

3.5 HARDWARE SETS

A. Following sets of hardware correspond to hardware symbols shown on drawings. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.

B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

ELECTRIC HARDWARE ABBREVIATIONS LEGEND:
ADO = Automatic Door Operator
EMCH = Electro-Mechanical Closer-Holder
MHO = Magnetic Hold-Open (wall- or floor-mounted)

SECURITY HARDWARE ABBREVIATIONS LEGEND:
AC = Access Control Device (Card reader, biometric reader, keypad, etc.)
ADO = Automatic Door Operator
DEML = Delayed Egress Magnetic Lock
DEPH = Delayed Egress Panic Exit Device
DPS = Door Position Switch (Door or Alarm Contact)
EL = Electric Lock or Electric Lever Exit Device
PB = Push-button Combination Lock (stand-alone)
RR = Remote Release Button
ELR = Electric Latch Retraction Exit Device
REX = Request-to-Exit Switch in Latching Device Inside Trim