

PROJECT SPECIFICATIONS



**WORK RELEASE: ANT-1008 TOWER
SIMULATION SYSTEM
ELMIRA, NY**

DATE: MAY 12, 2026

**PARSONS T5
955 L'ENFANT PLAZA,
SW SUITE #6500
WASHINGTON, DC 20024**

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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 GENERAL

1.1 Work Covered by the Subcontract Documents

- A. Project Location: Elmira Corning Regional Airport Traffic Control Tower (ELM ATCT). 276 Sing Sing Rd, Horseheads, NY 14845.
- B. The work consists of the following and incidental related work:
1. Remove and relocate tables, shelving, desks & storage cabinets per FAA direction.
 2. Remove return HVAC grille & cap with ceiling tile.
 3. Remove & replace wall bases per architectural drawing
 4. Close dampers for supply registers
 5. Provide new wall partition. Paint all TSS walls & baseboards to match
 6. Provide blackout windows
 7. Provide new anti-static carpet tile
 8. Provide ceiling cassettes
 9. Provide new HVAC system per Mechanical drawings
 10. Provide new heat pump unit
 11. Weatherproof and seal exterior wall and roof penetrations
 12. Install conduits & cabling to connect existing power panel to TSS room. All new circuit breakers will be required.
 13. Remove and replace existing light fixtures with new dimmable LED lighting on a dedicated switch.
- C. The Subcontractor is responsible for accomplishing all items of work in accordance with the applicable drawings, specifications, and conditions of the subcontract. Any additional labor, materials, equipment, and/or appurtenances not specifically detailed or specified, but required to complete the project, must be provided by the Subcontractor as an integral part of the scope of work specified.

1.2 Work Phases

Not Used

1.3 Work Under Other Contracts

Not Used

1.4 Products Ordered in Advance

Not Used

1.5 Contractor or Government Furnished Property

Not Used

1.6 Use of Premises

- A. Access to the Worksite: Access to the Worksite must be with approval of the Resident Engineer (RE). Access to the Worksite will be discussed prior to the start of construction. Only vehicles essential to the construction effort will be permitted in the construction area. If work is on an airport, all construction equipment and materials must be removed from the runway and/or taxiway safety areas at the end of each workday and as directed by the RE.
- B. Restrictions: Access to certain locations of the project may be restricted due to facility operations. Subcontractor must yield to facility operations that require use of the premises, and when instructed must vacate the area in question. Unless otherwise indicated, Subcontractor will have complete and exclusive use of the premises within the limits of the construction staging area for the execution of the Work.
- C. Subcontractor will have limited use of premises for construction operations as indicated on Drawings by the Subcontract limits.
- D. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of project site beyond areas in which the Work is indicated. Confine construction operations to ATCT property indicated in the drawings
 - 1. Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields).
- E. FAA Occupancy: Allow FAA occupancy of Project site.
- F. Driveways and Entrances: Keep driveways, parking garage, and entrances serving premises clear and available to FAA, FAA's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - 1. Schedule deliveries to minimize use of driveways and entrances.
 - 2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- G. Use of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.7 Badging Procedures

Badging is required by the FAA.

- A. FAA: The FAA has various levels of badging that provide the Contractors' Subcontractors different access / escort privileges. There are no costs for FAA badges. FAA badges will be coordinated with the Subcontractor by the Contractor's PM based on type of facility and need. The Subcontractor must follow the Contractor's Subcontractor Badging Procedure explicitly to obtain badges in a timely manner. The

Contractor's procedure and application forms will be provided upon subcontract award.

1. PIV: PIV badges will only be supported for subcontractors who need access to FAA computer networks. NOTE: FAA PIV badges issued under a different prime contract are NOT allowed. The subcontractor will need to obtain new credentials under the TSSC Contract. This badge may take 6 to 8 weeks to obtain.
2. Orange: This is the default badge for subcontractors working on an FAA site. In most circumstances it allows general access but does NOT allow for escort of non-badged personnel. Orange badges are valid for 1 year and must be surrendered to the Contractor at the end of the subcontract. This badge may take as little as 5 to 10 days to obtain.
3. Yellow: This badge allows, in most circumstances, escort privileges and is valid for 3 years. It requires a Tier 1 adjudication to include fingerprints. This badge may take 6 to 8 weeks to obtain and must be surrendered to the Contractor at the end of the subcontract.

B. Airport Operations Area (AOA): AOA badges are issued by the local airport authority. The Contractor will make every effort to provide the airport's badging requirements to the Subcontractor. However, it is up to the Subcontractor to verify these requirements and associated costs. The airport badging office phone number is: 620-952-0954.

1.8 Occupancy Requirements

- A. Full FAA Occupancy: FAA will occupy site and adjacent building and/or area during entire construction period. Cooperate with Contractor and FAA during construction operations to minimize conflicts and facilitate FAA usage. Perform the Work so as not to interfere with FAA's day-to-day operations. Maintain existing exits, unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Contractor FAA and authorities having jurisdiction.
 2. Provide not less than 72 hours' notice to FAA of activities that will affect FAA's operations.
- B. Partial FAA Occupancy: FAA will occupy the premises during entire construction period, except for areas under construction. Cooperate with FAA during construction operations to minimize conflicts and facilitate FAA usage. Perform the Work so as not to interfere with FAA's operations. Maintain existing exits, unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from FAA and authorities having jurisdiction.
 2. Provide not less than 72 hours' notice to FAA of activities that will affect FAA's operations.

1.9 Work Restrictions

- A. On-site Work Hours: Work must be generally performed at ATCT site during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.

1. Weekend Hours: On exception basis per approved schedule.
 2. Early Morning Hours: No Restrictions.
 3. Hours for Utility Shutdowns: No utility shutdowns are anticipated.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by FAA or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Resident Engineer not less than 3 days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Resident Engineer's or Project Manager's written permission.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

1.10 Existing Work

- A. In addition to Protection of Existing Vegetation, Structures, Equipment, Utilities and Improvements:
- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
 - b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Resident Engineer. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.11 Salvage Material and Equipment

- A. Items designated by the Resident Engineer to be salvaged remain the property of the Government. Segregate, itemize, deliver and off-load the salvaged property at the designated storage area located within 50 miles of the construction site.
- B. Provide a salvage plan, listing material and equipment to be salvaged, and their storage location. Maintain property control records for material or equipment designated as salvage. Provide a system for property control in the salvage plan. Store and protect salvaged materials and equipment until disposition to the FAA.

1.12 Specification Formats and Conventions

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "Master Format" numbering system.
1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Subcontract Documents. Sections in the specifications are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the specifications to determine numbers and names of Sections in the Subcontract Documents.
 2. Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Subcontract Documents is abbreviated. Words and meanings must be interpreted as appropriate. Words implied, but not stated, must be inferred as the sense requires. Singular words must be interpreted as plural, and plural words must be interpreted as singular where applicable as the context of the Subcontract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Subcontractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by the Subcontractor or by others when so noted.

1.13 Miscellaneous Provisions

A. Project Specific Acronyms, Abbreviations, and References:

1. **ATCT** Airport Traffic Control Tower.

B. On-Site Communications:

1. Resident Engineer- Daily stand-up meeting.
2. Project Manager- Weekly progress meeting with written minutes.

C. Compliance with Local and Other Codes: The Subcontractor will be responsible for coordination of all work. The Subcontractor must obtain any licenses or permits necessary to perform the Work not provided by the Contractor, and must comply with all applicable Federal, State, and local regulations in connection with the Work. The Subcontractor is responsible for paying for any permits or licenses required to perform the Work not provided by the Contractor, and such costs are deemed included in the Subcontract amount. The Contractor is not responsible for payment of any amount for actions taken by a state, local, or other jurisdiction because of Subcontractor's failure to comply with permit or license requirements.

1.14 Project Specific Insurance Requirements

Certificates of Insurance (COI): Subcontractor must submit COI's to the Subcontract Administrator in accordance with Section H of the Subcontract. In addition to the standard insurance requirements described in Section H, the following project specific requirements apply:

1. The insurance coverage for Commercial General Liability Insurance, including Contractual Liability and Completed Operations coverage, is hereby modified with limits of not less than *one million dollars (\$1,000,000)* combined single limits.
2. The insurance coverage for Automobile Liability Insurance set out in subparagraph 5.1A.3 of the General Conditions is hereby modified to provide all required coverage with limits of not less than one million dollars (\$1,000,000) combined single limit.

1.15 Project Safety and Quality

- A. Risk Management Plan (RMP): Subcontractor must submit evidence of their health and safety program (i.e. Corporate Health and Safety Plan) and complete a Work Release specific RMP Dashboard. The RMP Dashboard covers safety, security, and quality for the project and a template will be provided. The RMP must be submitted for approval 10 days prior to the start of work. Construction must not commence until the RMP has been approved by the PM.
- B. On Site Communications: Appropriate on-site communications must be established with the RE and Subcontractor to disseminate all information pertaining to safety requirements on site. This will include the notification of hazards brought on the site or created during the work. Notification may be done by posting hazard sheets on notice boards, or advising personnel during regular Toolbox Talks or daily meetings.
- C. Project Induction: All persons starting work on this site must go through a formal induction process and be briefed on a regular basis on changes in safety requirements depending on the progress of the Work. As part of the induction process, and as appropriate, the Subcontractor will be required to provide evidence of employee skills training.
- D. Competent Persons: Competent person training documentation must be provided where required by 29 CFR 1910 and 29 CFR 1926, such as for fall protection, excavations over four feet deep, crane and rigging operations, working in confined spaces, lockout/tagout of energy sources and equipment, and working with live electricity. Additional training records may be required on a case-by-case basis.
- E. Toolbox Meetings: Toolbox Meetings must be scheduled daily and used to review the tasks, safety hazards and mitigations for the planned work. Subcontractor will utilize AHAs that were approved as part of the RMP to lead the discussion on safety rules and various site-specific issues. The aim is to ensure that all workers on site are aware of the hazards and ensure that the required mitigations are in place and functioning.
- F. List of On-Site Personnel: A list of all Subcontractor personnel as well as a list of lower tier subcontractor personnel working on site must be maintained. The list of on-site personnel must be provided to the RE daily.
- G. Liaison Person: If English is a second language of Subcontractor employees, then Subcontractor must maintain an on-site liaison person who can effectively communicate with on-site personnel. Subcontractor must also have a person on site that is trained in First Aid / CPR / AED in case of an injury or accident to any of its personnel.
- H. Hazard Analysis: All hazards brought on site or created during the Work must be identified and controlled. Activity Hazard Analysis (AHA) should be used to analyze the tasks within the various elements of work to identify significant safety hazards and detail the method of control. Hazardous substances that may be used on site must have the appropriate Safety Data Sheets (SDS) and be addressed as part of the AHA analysis.
- I. Incident/Accident Reporting: All incidents, accidents, injuries, near-misses and unexpected hazards are to be reported to the RE immediately. Investigation and root cause reports are to be provided to the RE and

PM within 48 hours. Accident scenes must not be disturbed until a full and completed investigation has occurred with the RE and other required personnel. Subcontractor will provide accident reports in alignment with the requirements of Section 01 35 29, 1.10.

- J. Subcontractor Safety Inspections: The Subcontractor is expected to carry out regular documented safety inspections (minimum weekly) on its work areas while on site. Copies of the inspection reports must be provided to the RE for discussions at safety meetings. Any recommended completed corrective action will be advised at these meetings.
- K. Two Week Look Ahead: At a minimum, the Subcontractor must meet with the RE weekly and provide a Two Week Look Ahead that provides the following information:
 - a. The next two weeks scope of work
 - b. Identified safety risks, exposures, hazards and issues
 - c. Identified tasks that will require additional permitting or involve regulatory issues i.e. the development of a new waste stream.
 - d. Tasks with environmental risk if significant spills or releases
 - e. Control Measures
 - f. Additional AHAs as may be required
 - g. Subcontractors mobilizing and demobilizing plans
 - h. Audits/Inspections Scheduled
 - i. Competent Person Changes
 - j. Planned Orientation and Training
 - k. Recommendations, comments and concerns
- L. Take 5: As a principal of Operational Risk Management, if something does not feel right subcontracted employees must contact the RE immediately, "Take 5" and perform the following actions:
 - 1 - Stop: Step back and observe the situation.
 - 2 - Think: Contemplate your plan of action
 - 3 - Assess: Consider new hazards or operational risks.
 - 4 - Manage: Talk about the issue, mitigate it, share it.
 - 5 - Proceed: Safely complete the task.

1.16 Drugs, Alcohol, and Weapons

FAA facilities are federal government property and are subject to the same rules and regulations as any other federal facility regardless of the location of the facility, i.e., Airport, City owned building, etc. All persons entering the premises, including their vehicles are subject to search. Possessing any of the items listed below may result in expulsion from the site and/or arrest and prosecution. The following are specific items of concern that are not allowed on FAA property. This is NOT an all-inclusive list.

- A. Schedule 1 Drugs: All Federal Food and Drug Administration Schedule 1 drugs. This includes but is not limited to marijuana.
- B. Schedule 2 Drugs: All Federal Food and Drug Administration Schedule 2 medication without a prescription. Persons suspected of being under the influence of these medications, even with a prescription, may be subject to removal from the site.
- C. Alcohol: Alcoholic beverages whether in a closed sealed container or empty containers.
- D. Weapons: Guns (including BB, pellet, air-soft, and toy), ammunition, knives with blades longer than 2.5", and any other item readily capable of causing serious injury or death as defined by 18 USC Section 930.

1.17 Pre-Construction Meeting

The PM will schedule a pre-construction meeting after Notice of Award. Required attendance includes Parsons Subcontract Administrator, the Subcontractor's Project Manager, Subcontractor's Superintendent, and major lower tier subcontractors. Acknowledgements of all reviews made at the session will be noted in the meeting minutes.

1.18 Site Inspection

- A. The Contractor reserves the right to enter the premises during the term of the Subcontract for quality assurance work inspections and/or maintenance of existing navigational and communication facilities.
- B. After NTP and prior to initiating Work, Subcontractor and RE must conduct joint inspections of the jobsite to determine the existing conditions and note any existing damage or defects. Existing damage or defects will be used as the basis for determination of damages caused by the Subcontractor's operations.
- C. Subcontractor will be responsible for the cost of any repair caused by Subcontractor's operations or the operations of its lower tier subcontractors. All damage to the existing Site including, but not limited to, existing utilities and cables, facilities, equipment, buildings, and vegetation must be repaired. All such repairs must match the original finish and must be made utilizing materials, equal to or greater than the original materials, as approved by RE. All repairs must be made with no additional cost to Contractor.
- D. Contractor retains the right to inspect all Work on the project but has no obligation to do so. Contractor's inspections and tests are for the sole benefit of Contractor and do not:
 - 1. Relieve the Subcontractor or its lower tier subcontractors of the responsibility to provide adequate quality control measures.
 - 2. Relieve the Subcontractor or its lower tier contractors of the responsibility for damage to or loss of material before acceptance.
 - 3. Constitute or imply acceptance.
- E. The presence or absence of the RE does not relieve the Subcontractor or its lower tier contractors from any Subcontract requirement, nor is the RE authorized to change any requirement of the Subcontract.

1.19 Special Scheduling Requirements

- A. Protect existing facilities and equipment from physical or electrical damage as a result of accidental or incidental negligence, such as, but

not limited to, disruption of standby power to the facility or equipment.

- B. All preparatory work must be completed by the Subcontractor prior to shutdown/cutover to minimize downtime. The requested time and date of shutdown and cutover must be approved by the RE a minimum of two working days in advance of the requested shutdown or cutover. FAA personnel will perform the actual shutdown/cutover of systems that affect operations.
- C. In the event any services are interrupted, restore services with a full crew available to restore such services on a 24-hour basis, including Work during holidays and weekends, at no additional cost to Contractor or delay in the Schedule.
- D. Request any utility interruptions in writing per Facility requirements but not less than five working days before the scheduled interruption, unless otherwise specified. RE review and FAA approval is required before interruption. In this notification, the Subcontractor must certify that all equipment, materials, and personnel necessary to conduct such testing will be available on the scheduled date and that the systems have been pre-checked by personnel and are ready for performance and acceptance testing.
- E. Subcontractor must also confirm that all operations and maintenance manuals have been submitted and approved. No performance and acceptance testing will be permitted until the operations and maintenance manuals have been approved.
- F. Coordinate all required outages with Contractor through the RE. The Subcontractor must determine quantity and duration of outages required to complete the Work. The Subcontractor may have to schedule work and outages at a time when air traffic is at a minimum. This could mean late night or early morning hours.
- G. Do not interrupt services outside of permitted, scheduled outage periods.

1.20 Project Specific Work Plans

- A. **Required Work Plans:** The Subcontractor must submit written work plans in accordance with the Subcontract submittal requirements for critical items of work set out in this Section, in the Technical Specifications, or elsewhere in the Subcontract Documents. Work associated with the required work plans must not commence until approval has been provided.
- B. **Underground Utility Damage Prevention Plan:** Subcontractor is responsible for complying with all OSHA regulations related to underground utility damage prevention. Subcontractor must take all reasonable steps necessary to make certain that all active, abandoned, or unknown utilities are identified. Such steps are to include the use of 811 **and** the utilization of a firm acceptable to the Contractor and knowledgeable in Subsurface Utility Designation techniques and underground utility designation best practices published by the Common Ground (CGA) Alliance. A copy of CGA's best practices can be found at: <http://commongroundalliance.com/best-practices-guide.htm>. The elements of the prevention Plan are detailed in Section 01 35 29 - Workplace Safety and Health.

- C. Crane Work Plan: The subcontractor must submit the work plan of the crane company, including a site-specific emergency response plan, pick plan, and certifications for both the operator and equipment.
1. Notify the RE at least 48 hours prior to the arrival of any crane at the work site.
 2. On the day of arrival of the crane at the work site, and every day the crane is at the work site thereafter notify the RE of its presence and location.
 3. The following information for each crane must be given to the Resident Engineer:
 - i. Boom or lead height.
 - ii. Weight.
 - iii. Crane must be grounded.
 - iv. Crane must have an up-to-date Certificate of Insurance.
 - v. Crane operator must have an up-to-date Operator License or Certification.
 - vi. Crane must have appropriate flags and lights on top.
- D. Fall Protection Work Plan: Whenever activities are to be performed 6 feet or higher above a lower level by Subcontractor personnel (at all tiers), the Subcontractor must:
1. Include a detailed Fall Protection Plan as part of the Safety and Health Plan submittal. The Fall Protection Plan must identify specific situations where fall protection is required by all subcontract and lower-tier subcontract personnel who will be engaged in activities at elevations of 6 feet or higher, identify the fall protection system and associated components to be used, and explain the specific methods and procedures to be followed to assure 100% fall protection.
 2. 100% fall protection means that the employee is protected 100% of the time by an approved fall protection system regardless of activity. 100% of the time an employee is engaged in activities at elevations of 6 feet or higher; the employee must be protected - without exception. Guardrail Systems when used as the means of fall protection on the job must comply with 29 CFR 1926.502(b). Additionally, these systems must:
 - i. Be provided on every open-sided floor or platform 4 feet or more above adjacent floor or ground level on all open sides, except where there is an entrance to a ramp, stairway, or fixed ladder.
 - ii. Consist of a top rail, intermediate rail, and posts, and must have a vertical height of 42 inches nominal from upper surface of top rail to floor, platform, runway, or ramp level. When used mid-rails must be half the distance between the top rail and to floor, platform, runway, or ramp level.
 - iii. Be capable of withstanding, without failure, a force of at least 200 pounds applied within 2 inches of the top edge of the top rail, in any outward or downward direction, at any point along the top edge.
 - iv. Be capable of withstanding, without failure, a force of at least 150 pounds applied to the mid-rail, in any outward or downward direction.

- v. Use toe boards or screens when objects could fall to a lower level.
3. Safety Net Systems, when used as a means of fall protection on the job site, must comply with 29 CFR 1926.502(c). Additionally, these systems must:
- i. Be installed as close as practicable under the walking/working surface on which employees are working, but in no case more than 30 feet below such level.
 - ii. Extend outward from the outermost projection of the work surface as follows:
 - 1. Vertical distance from working level to horizontal plane of net
 - a. Up to 5 feet
 - b. More than 5 feet up to 10 feet
 - c. More than 10 feet
 - 2. Minimum required horizontal distance of outer edge of net from the edge of the moving surface:
 - a. 8 feet
 - b. 10 feet
 - c. 13 feet
 - iii. Be capable of absorbing an impact force equal to that produced by the required drop test. The drop-tested must be performed at the job site after initial installation and before being used as a fall protection system, whenever relocated, after major repair, and at 6-month intervals if left in one place. The drop-test must consist of a 400-pound bag of sand 30 ± inches in diameter dropped into the net from the highest walking/working surface at which employees are exposed to fall hazards, but not from less than 42 inches above that level.
 - iv. Be installed with sufficient clearance under them to prevent contact with the surface or structures below when subjected to an impact force equal to the required drop test.
 - v. Be inspected at least once a week for wear, damage, and other deterioration. Defective nets and components must be removed from service.
 - vi. Be inspected daily, at the beginning and end of each shift, and all materials, scrap pieces, equipment, and tools which have fallen into the safety net must be removed as soon as possible from the net.
 - vii. Be inspected after any occurrence that could affect the integrity of the safety net system. Defective nets and components must be removed from service.
4. Personal Fall Arrest Systems when used as the means of fall protection on the job site must comply with 29 CFR 1926.502 (d). The subcontractor must identify, in writing, an observer to be present on the ground at all times when personnel are engaged in activities requiring the use of these systems. (This person must have certification by training and experience as a competent person in

fall protection and must not have any other duties that will encumber the observing duties.) Additionally, these systems must:

- i. Utilize full body harnesses (which meet ANSI A10.14-1991) to distribute the fall arrest forces as defined in 29 CFR 1926.500(b). Body belts must not be used.
 - ii. Utilize shock absorbing lanyards or retractable lifelines with locking type snap hooks to prevent "roll-out."
 - iii. Limit the free fall distance, as defined in 29 CFR 1926.502(d)(16)(iii), to less than six feet and minimize associated swing hazards.
 - iv. Ensure anchor points meet the 5,000-lb. strength requirements outlined in 29 CFR 1926.502(d)(15).
 - v. Ensure that all fall protection systems and components are inspected prior to each use and continue to be inspected by a competent person in accordance to the requirements set forth in 29 CFR 1926.502(d)(21). The Subcontractor must maintain records of inspection at the job site for review by Parsons personnel and/or regulatory agencies.
5. Positioning Device Systems must comply with 29 CFR 1926.502(e). The Subcontractor must identify, in writing, an observer to be present on the ground at all times when personnel are engaged in activities requiring the use of these systems. (This person must have certification by training and experience as a competent person in fall protection and must not have any other duties that will encumber the observing duties.) Additionally, these systems must:
- i. Utilize full body harnesses (which meet ANSI A10.14-1991). Body belts must not be used.
 - ii. Utilize positioning lanyards with locking type snap hooks to prevent "roll-out."
 - iii. Limit the free fall distance, as defined in 29 CFR 1926.502(e)(1), to less than two feet.
 - iv. Ensure anchor points meet the 3,000-lb. strength requirements outlined in 29 CFR 1926.502(e)(2).
 - v. Ensure that all positioning device systems and components are inspected prior to each use and continue to be inspected by a competent person in accordance to the requirements set forth in 29 CFR 1926.502(e)(9). The Subcontractor must maintain records of inspection at the job site for review by Parsons' personnel and/or regulatory agencies.
6. Warning Lines and Controlled Access Zones when used as means of fall protection must comply with the requirements of 29 CFR I 926.502(f & g). Additionally, use of warning lines and controlled access zones must require the designation of a competent person to perform as a safety monitor. The competent person must be on the same working level as employees, be able to readily observe and communicate orally with employees on the working level, and not have any other duties that will encumber the safety monitoring duties.
7. Fall Protection training must be provided as described in 29 CFR 1926.503(a) and 29 CFR 1926.21(b)(2), be conducted by a competent

person according to 29 CFR 1926.503(a) (2) and be current within 12 months of issuance of the Notice to Proceed.

8. A training certification record showing the names of employees trained, the date(s) of the training, training topics, and the signature of the trainer in accordance with 29 CFR 1926.503 (b & c) must be submitted to Parsons.
9. A Notice to Proceed will not be issued until written evidence is received by Parsons showing compliance with the fall protection training requirement. All Subcontractor employees will be required to have on file with Parsons, their training records before they will be permitted on the job site. Delays and related costs associated with the Subcontractor's failure to comply must be the sole responsibility of the Subcontractor.

E. Storm Water Pollution Prevention Plan (SW3P): The aim of the SW3P is to prevent silt run off from rain and other water related events. The SW3P is a living document. Regardless of the acreage of work, the SW3P must be provided. The contents and format of the Plan must be in accordance with State or Federal requirements.

1.21 Miscellaneous Requirements

Layout of Work: The Subcontractor must layout its work from established base lines, grades, and benchmarks indicated on the drawings, and will be responsible for all measurements in connection with the layout. The Subcontractor should furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the Work. The Subcontractor will be responsible for the execution of the Work to the lines and grades that may be established or indicated by the RE. The Subcontractor will also be responsible for maintaining and preserving all stakes and other marks established by the Contractor until authorized to remove them. If such marks are destroyed by the Subcontractor or through its negligence before their removal is authorized, the Contractor may replace them and deduct the expense of the replacement from any amounts due or to become due to the Subcontractor.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 11 00

SECTION 01 31 13 - PROJECT COORDINATION

PART 1 GENERAL

This section specifies requirements for requests for information (RFI) and progress meetings. Related sections of the subcontract documents include: 01 11 00 Summary of Work, 01 32 00 Construction Progress Documentation, and 01 33 00 Submittal Procedures.

1.1 Request for Information Procedures

- A. Use Contractor's RFI Form. Contractor will provide sample forms at the Pre-Construction Meeting. Complete the form for any RFIs and submit via the KSN construction site.
- B. RFIs must only address technical questions or concerns and/or alternative technical solutions. A RFI that includes discussion regarding specific cost or schedule demands will be rejected.
- C. RFIs identifying a technical question relating to the design or construction of the project must be submitted to the RE for disposition by the PM. Attach drawings, sketches, and other clarifying documents along with recommended resolution if known. PM will respond and transmit Contractor's response via the KSN construction site.
- D. If Subcontractor determines that Contractor's response to the RFI may impose a cost or a schedule impact on the Work, Subcontractor must inform the PM in writing with copies to the RE and SA within (14) calendar days from receipt. Notification must not include cost or schedule impact. Subcontractor must submit the cost and schedule impact separately only to the SA. Subcontractor is not to proceed with any Work that incurs additional cost or time based on a RFI. If no cost or schedule impact notification is received from Subcontractor within specified time, Subcontractor will be deemed to have accepted Contractor's response and responsibility for Work described therein.
- E. Subcontractor must maintain its own RFI log. The RFI number must be prefixed by Contractor assigned number followed by a dash followed by a sequential number starting at 001.

1.2 Field Instruction Procedures

- A. Contractor may issue an order via Field Instruction (FI) to the Subcontractor to perform a change in the work. This instruction may be in the form of revised plans or other information attached to the FI that provides the Subcontractor with clarifications or additional information on what work is to be performed.
- B. If Subcontractor determines that Contractor's direction in the Field Instruction may impose a cost or a schedule impact on the Work, Subcontractor must inform the PM in writing with copies to the RE and SA within (14) calendar days from receipt of the Field Instruction. The notification must not include cost or schedule impacts. The cost or schedule impacts must be submitted separately only to the SA.

1.3 Progress Meetings

- A. Meetings with Subcontractor must be held weekly with date, time, and location to be specified by RE. The purpose of these meetings will be to conduct a joint review, review the quality of the on-going Work, and

agree on project progress and subsequent submittals of updated and actual progress schedules. During these meetings the Subcontractor must provide the RE with a two week look ahead as defined in Section 01 11 00, K.

- B. The Subcontractor's Superintendent or representative must meet with the RE and, if directed, with the PM daily for a Play of the Day. The POD is intended as a 24 hour look ahead and should not last more than 15 minutes. The POD must address planned work for the next day, tools, materials, testing services, and equipment needed, and any AHAs needed to review during the morning toolbox talk. The purpose of the POD is to ensure adequate planning has been done with regards to safety, security, quality, and schedule. The POD should address availability of proper personnel, equipment, tools, and work plans for the following day. It should be done in the early afternoon or before to allow the subcontractor to acquire any missing assets needed to perform the work. Work not included in the POD will NOT be permitted that working day and must be addressed for the following workday.

1.4 Pre-Installation / Pre-Work Meetings

When required in individual specification sections, convene a pre-installation meeting at Worksite before starting work requiring a written work plan. The purpose of the meeting will be to review the Subcontractor's work plan, determine acceptability of the Subcontractor's work plan, and provide authorization to proceed with the Work if the work plan is acceptable. Require attendance of parties directly affecting, or affected by, work of the specific section and RE. Notify the RE and PM as required by the Facility, but no less than two workdays before the meeting.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 31 13

SECTION 01 32 16 - PROJECT SCHEDULE

PART 1 GENERAL

1.1 Summary

This section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.

1.2 Submittals

1. Baseline Project Schedule
2. Monthly Schedule Updates

1.3 General Requirements

- A. Within 15 calendar days after contract award and prior to the start of work, prepare and submit to the Project Manager a Baseline Construction Schedule in the form of a Bar Chart Schedule. The approval of a Baseline Construction Schedule is a condition precedent to subcontractor starting work or construction stages of the contract.
- B. Show in the schedule the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities. The scheduling of the entire project is required.

1.4 Schedule Format

- A. The Schedule must, as a minimum, show work activities, submittals, Contractor review periods, material/equipment delivery, utility outages, on-site construction, inspection, testing, and closeout activities. The Schedule must be time scaled and generated using an electronic spreadsheet or scheduling program.

1.5 Schedule Monthly Updates

- A. Update the Schedule at monthly intervals or when the schedule has been revised. Keep the updated schedule current, reflecting actual activity progress and plan for completing the remaining work. Submit copies of purchase orders and confirmation of delivery dates as directed by the Project Manager.
- B. Submit a narrative report, identifying and justifying the following:
 1. Progress made in each area of the project
 2. Critical (longest) path activities
 3. Date/time constraints
 4. Listing of changes made between the previous schedule and current update
 5. Pending items and statuses including permits, change orders, and time extensions
 6. Current and anticipated delays describing cause of delay and mitigation measures to minimize
 7. Descriptions of current or future schedule issues

1.6 3-Week Look Ahead Schedule

- A. Prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Construction Schedule and update each week to show the planned work for the current and following two-week period. Additionally, include

upcoming outages, closures, and meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. Activities must not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 32 16

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 Submittal Descriptions

A. Submittal requirements are specified in the technical sections.

1.2 Submittal Register

A. The Subcontractor is solely responsible for creating a Submittal Register identifying whether the submittals are samples, cut sheets, certified test results, and adding additional submittals as required by specifications, drawings or as recommended by a manufacturer. As applicable, the submittal register must state the action required for testing and inspection with the name of the persons authorized to review the submittal. The Subcontractor must submit one copy electronically for approval within 10 calendar days of Subcontract Award. At a minimum, the following submittal items must be provided to the Contractor for review and approval prior to installation:

- Construction Progress Schedule
- Schedule of Values
- Risk Management Plan (RMP)
- Inspection and Test Plan (ITP)
- Submittal Register
- Quality Control plan
- Submittals Required by Specification
- Materials and Products Identified by Specification
- Pre-Installation and Work Plans
- Qualifications of utility designation firm or person
- Qualifications of licensed tradesmen where licensing or certifications are required
- Qualifications and certifications of independent inspections and testing firms

1.3 Shop Drawings

A. Within the terms of the contract, submittals are considered to be 'shop drawings'

B. The Subcontractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the Work, and that it has investigated and satisfied itself as to the conditions which can affect the Work or its cost, including but not limited to: conditions bearing upon transportation, disposal, handling, and storage of materials; the availability of labor, water, electric power, and roads; uncertainties of weather, river stages, tides, or similar physical conditions at the site; the conformation and

conditions of the ground; and the character of equipment and facilities needed preliminary to and during work performance.

- C. The Subcontractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by Contractor, as well as from the drawings and specifications made a part of this Subcontract. Any failure of the Subcontractor to take the actions described and acknowledged in this paragraph will not relieve the Subcontractor from responsibility for properly estimating the difficulty and cost of successfully performing the Work, or for proceeding to successfully perform the Work without additional expense to Contractor.
- D. Contractor assumes no responsibility for any conclusions or interpretations made by the Subcontractor based on the information made available to Subcontractor. Nor does Contractor assume responsibility for any understanding reached or representation made concerning conditions that can affect the Work by any of their respective officers or agents before the execution of this Subcontract, unless that understanding, or representation is expressly stated in this Subcontract.

1.4 Design-Build Submittals

- A. Designer of Record (DOR) approval is required for extensions of design; critical materials; any variations from the Solicitation, the Accepted Proposal, or the completed design; equipment whose compatibility with the entire system must be checked; and other items as designated by the Project Manager. Provide the Contractor with the number of copies designated hereinafter of all DOR approved submittals. The Contractor may review any or all Designer of Record approved submittals for conformance with the Solicitation, the Accepted Proposal, and the completed design. The Contractor will review all submittals designated as varying from the Solicitation or Accepted Proposal.
- B. The Contractor will review all intermediate and final design submittals for conformance with the technical requirements of the Solicitation. Review will be only for conformance with the applicable codes, standards, and contract requirements.
- C. Contractor's approval is required for any proposed variation from the accepted design that still complies with the contract before the Subcontractor is authorized to proceed with material acquisition or installation. If necessary to facilitate the project schedule, before official submission to the Contractor, Subcontractor may discuss with the Resident Engineer and Project Manager a submittal proposing a variation. However, the Contractor reserves the right to review the submittal before providing an opinion. In any case, the Contractor will not formally agree to or provide a preliminary opinion on any variation without the Subcontract Administrator's approval. The Contractor reserves the right to reject any design, variation that may affect furniture, furnishings, equipment selections, or operational decisions that were made, based on the reviewed and concurred design.

1.5 Warranties and Guarantees

A. Subcontractor must provide warranties/guarantees executed by the respective manufacturers, suppliers, and lower tier subcontractors for all installations as required in the Subcontract or as is customarily provided with the piece of equipment or system. All warranties are to be executed, in writing, for the benefit of the FAA. Provide all warranties in a 3-ring binder with an index and tabs for each section. Subcontractor must enforce all warranties for the benefit of the FAA if so directed by the FAA or Contractor. In the event the Subcontractor's warranty has expired, the FAA may bring suit at its expense to enforce a subcontractor's, manufacturers, or supplier's warranty. Subcontractor must provide complete information for each item as follows:

1. Product or work item.
2. Firm, with name of principal, address, and telephone.
3. Scope.
4. Date of beginning of warranty.
5. Duration of warranty.
6. Proper procedure to evoke the warranty in case of failure.
7. Instances that might affect the validity of warranty.
8. Subcontractor name or responsible principal, address, and telephone number.
9. Extended warranties normally provided by manufacturers that are beyond the warranty of construction must be specifically noted.

B. Equipment Warranty Tags. The Subcontractor must furnish and install equipment warranty tags on all Subcontractor furnished and installed equipment in accordance with the following:

1. Lettering must be Arial bold, upper case, and easily readable.
2. Tag must be of a durable type material and of a type that can be written on.
3. The tag must state the following:
 - a. The title "Equipment Warranty".
 - b. Subcontractor's name and Subcontract Number.
 - c. Month-day-year (mm-dd-yy) the warranty expires.
 - d. Point of contact, including name and telephone number.
 - e. Manufacturer.

1.6 Submittal Submission Requirements

- A. One (1) electronic copy, of all shop drawings and/or submittal data must be submitted for review and acceptance through the KSN Construction Site for this project.
- B. The Subcontractor must ensure that all submittals are made with adequate time for review and acceptance, including re-submittals, so as not to delay the job. The Contractor will coordinate submittal review and will

make best effort to return initial submittals within 10 calendar days and re-submittals within three (3) business days. Work must not commence prior to acceptance of required submittals by Contractor.

- C. Subcontractor must check and certify submittals are true and correct prior to delivery to the Contractor. The Subcontractor is cautioned that the time stipulated in this section does not include any allowance for re-submittal in cases where the PM determines that the Subcontractor's approval of the submittal is not adequately justified. Any delay caused by inadequacies in the Subcontractor's submittal will not entitle the Subcontractor to an extension of time or additional compensation. Lack of completeness or inadequate description will be justification for disapproval.

1.7 Submittal Evaluation

- A. The Contractor will evaluate all submittals requiring Contractor responsive action. The Subcontractor remains responsible for complying with Subcontract requirements, referenced standards, and regulations. The Contractor's evaluation will not relieve the Subcontractor of the responsibility for any error that may exist. Unsolicited submittals not required by the Contract Documents will be returned with the notation that the submittal is not required by the Subcontract and that the Contractor has not reviewed and has no comment on the submittal. The Contractor's evaluation will result in only one of four responses as follows:

- **Approved:** Work covered by the submittal may proceed provided Subcontractor complies with requirements of the Contract Documents.
- **Approved as Noted:** Work covered by the submittal may proceed contingent upon Subcontractor acceptance of the corrections and/or notations and provided Subcontractor complies with the requirements of the Contract Documents.
- **Revise and Resubmit:** Work covered by the submittal may not proceed until the submittal is revised in accordance with the corrections and/or notations and resubmitted.
- **Rejected:** The submittal does not conform to the intent and requirements of the Contract Documents and the Subcontractor must resubmit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 33 00

SECTION 01 35 26 - GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 General

This section identifies some of the requirements of the OSHA Construction Standard.

1.2 Subcontractor Responsibility

- A. General Safety Provisions. The Subcontractor must bear full responsibility to provide safe working conditions for its employees and subcontractors. The Subcontractor must not permit any employee or subcontractor to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to the health and safety of the employee.
- B. Accident Prevention. The Subcontractor must bear the responsibility of maintaining an accident prevention program such that frequent and regular inspections of the job site, materials and equipment are made by a competent person designated by the employer.
- C. Use of Equipment. The Subcontractor must not permit the use of any machinery, tool, material, or equipment that is not in compliance with OSHA regulations. The employer must permit only those employees qualified by training and/or experience to operate equipment and machinery.

1.3 Contractor Responsibility

- A. The Contractor will not be held responsible for safety inspections to assure Subcontractor conformance with the OSHA safety regulations. The Contractor, however, reserves the right to notify the Subcontractor of any deficiencies regarding worker safety.
- B. The Contractor will evaluate the Subcontractor on its safety performance, including that of its subcontractors. The number and severity of safety and security violations will be considered in this evaluation. Subcontractor safety violations are cause for termination for default, may result in notification of the Subcontractor's bonding company, and will affect the Subcontractor's opportunity to propose on future work. Failure to correct such deficiencies will result in the Contractor reporting such deficiencies to the FAA and may impact the Subcontractor's ability to work on future Contractor contracts.

1.4 OSHA Regulations

- A. The Subcontractor must comply with the latest Occupational Safety and Health Administration regulations (CFR 29 Part 1926) regarding safety in the work area.
- B. The Subcontractor must obtain copies of non-FAA referenced documents without additional cost to the FAA. If Subcontractor requests, a copy of FAA directives may be obtained by contacting the Subcontract Administrator.
- C. The Subcontractor is not relieved from adhering to other OSHA requirements not listed herein. The Subcontractor must consult the latest referenced OSHA documents for safety regulations.

1.6 CFR 29 Part 1910 -- General Industry Standards Applicable to Construction Industry

This section contains a partial listing of the referenced OSHA standards. The Subcontractor is responsible for adhering to all applicable regulations including those not specifically referenced herein.

- A. Section 1910.147. Subcontractor must maintain a written hazardous energy control procedure in accordance with CFR 29 1910.147. The written procedure must describe contractor's responsibilities regarding shift changes or personnel changes. A specific coordinated lockout/tagout procedure must be recorded in writing and signed by the Subcontractor and Subcontract Administrator with copies to each party.
- B. Section 1910.120. The Subcontractor must develop and implement an Emergency Response and Contingency Plan in accordance with OSHA Standard 29 CFR 1910.120. In the event of an emergency associated with remedial action, the Subcontractor must, without delay, take diligent action to remove or otherwise minimize the cause of the emergency; alert the Contractor; and institute whatever measures might be necessary to prevent any repetition of the conditions of actions leading to, or resulting in, the emergency. Emergency contact names and telephone numbers must be posted at all project phones and in site-support vehicles as well as included within the plan.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 35 26

SECTION 01 35 29 - HEALTH, SAFETY AND EMERGENCY RESPONSE PROCEDURES

PART 1 GENERAL

1.1 Section Includes

This section identifies Subcontractor requirements for workplace safety and health as generally required by local, state, and Federal regulations.

1.2 Subcontractor Responsibility

Subcontractor must comply with safety, health, and emergency response provisions of this Subcontract. The provisions of this section represent minimum requirements and must not supersede additional requirements stated within the Subcontract or local, state, and Federal regulations.

1.3 Personal Protection

The Subcontractor must provide all on-site personnel with appropriate personal safety equipment and protective clothing and ensure that all safety equipment and protective clothing are kept clean and well maintained. The minimum PPE for all personnel onsite is a hard hat, safety glasses, hi-vis safety vest and steel-toe/composite toe work safety boots. Additional PPE must be provided contingent upon the hazards and mitigations identified in the Subcontractor Activity Hazard Analysis (AHA) for that task.

1.4 First Aid and Emergency Response Equipment

The Subcontractor must provide for appropriate emergency equipment including an appropriately sized and type first aid kit, a 2A:20B:C-rated fire extinguisher, spill control/containment equipment, and supplies of sufficient quantity to handle potential accidents/incidents related to the nature of the work being accomplished. A listing of emergency phone numbers and points of contact for fire, hospital, police, ambulance, and other appropriate emergency agencies is part of the RMP template provided and the RMP must be onsite and readily available for reference at any time.

1.5 Notification of Spills and Discharges

- A. Subcontractor must notify proper local authorities immediately in the event of a spill or discharge of potentially harmful or hazardous materials. Following notification of the local authorities, the Subcontractor must notify the RE, PM, and Subcontract Administrator immediately. If the spill or discharge is reportable under local, state or Federal regulations, and/or human health or the environment is threatened, the Subcontractor must notify the National Response Center at 1-800-424-8802 and the state's Department of Natural Resources where the spill or discharge occurred.
- B. Decontamination procedures may be required after clean-up to eliminate traces of the substance spill or reduce it to an acceptable level, as determined by the RE. Complete clean-up may require removal and disposal of contaminated soils. Personnel and equipment decontamination must occur as specified in this section. All contaminated materials, including solvents, cloth, soil, and wood, that cannot be decontaminated must be properly containerized, labeled, and properly disposed of as soon as possible.
Personnel and equipment that have come into contact with contaminated materials must be decontaminated. A detergent that has been shown to be successful and effective for removing the hazardous material must be

used as the decontamination solution. Following washing, items must be rinsed with clean water.

1.6 Project-Generated Wastes

The Subcontractor must dispose of project-generated wastes that are or may have become contaminated (i.e., PCBs or asbestos) in compliance with local, State and Federal guidelines. Such wastes include, but are not limited to, disposable clothing, decontamination solvents, and decontamination wash waters. Subcontractor must provide Contractor with waste manifests for the disposal of all project-generated wastes.

1.7 Confined Space

- A. Definition. A confined space is a space, which, by design, has limited openings for entry and exit, unfavorable natural ventilation that could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces (as defined by OSHA) include, but are not limited to, storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.
- B. In general, FAA confined spaces include vaults, lift stations, crawl spaces, small engine generator rooms, sewers, sumps, chillers, pits, boilers, tunnels, manholes, cooling towers, tanks, and watershed.
- C. Applicable Documents. The following publications of the issue in effect on the date of the solicitation form a part of this specification and are applicable to the extent specified herein.
 - 1. American National Standards Institute (ANSI)
 - 2117.1 Safety Requirement for Confined Space
 - 2. OSHA Standards
 - 29 CFR 1910.268 Telecommunications
 - 29 CFR 1910.269 Electric Power Transmission, Generation, and Distribution
 - 29 CFR 1910.46 Permit-Required Confined Spaces
 - 29 CFR 1926.956 Underground Lines
- D. Requirements. Prior to any admittance into a confined space as defined in this Section, the Subcontractor must perform a hazard evaluation. The hazard evaluation must include testing the atmosphere for oxygen content, the presence of toxic gases, and the presence of explosive or flammable gases.

1.8 Underground Utility Damage Prevention Excavation Requirements

The Subcontractor is responsible for complying with all OSHA regulations related to underground utility damage prevention. The Subcontractor must take all reasonable steps necessary to make certain that all active, abandoned, or unknown utilities are identified. Such steps are to include the utilization of a third-party utility locating firm acceptable to the Contractor and knowledgeable in Subsurface Utility Engineering (SUE) techniques, and competent to perform utility designation in conformance with the National Utility Locating Contractors Association (NULCA) Standard 1 for Professions Competence Standards for Locating Technicians or other written standard acceptable to the Contractor.

Additional steps include non-mechanical excavation techniques within 5' either side of known utilities such as wet or dry vacuum excavation, hand digging with non-pointed shovels, or other methods to be approved by the Parsons National Quality Manager.

An Underground Utility Damage Prevention Plan must be submitted for approval at least 2 weeks prior to any planned excavation for the Contractor's review and approval. At a minimum, the Plan must include the following:

1. A map or drawing of the areas of excavation showing:
 - i. The limits of excavation where white lining will occur
 - ii. Known utilities from the Engineer's documents
 - iii. Known utilities from other available documents
2. Name of the third-party firm
3. Third party firm's documentation as an accredited member of NULCA
4. Name of individual to perform the locating
5. Locating individual's training and experience information
6. Proposed method(s) of locating
7. Means of marking utilities (both known and newly found)
8. Frequency and means of refreshing markings
9. Emergency contact information for known utilities
10. Means of non-mechanical excavations within 5' of identified utilities
11. A list of qualified subcontractors such as plumber, electrician, fiber optical cable splicer, and others as applicable for emergency repair purposes. Due to current FAA/TSA/Airport security requirements, the Subcontractor must ensure that these subcontractors have passed any airport security and registration requirements so they can be presented immediately at the job site when emergency repair is warranted.

Upon completion of the utility locating submit the following:

1. Field sketch with legend from the locating firm
2. Emergency contact information for newly found utilities

The field sketch and all emergency contact information must be maintained on site in an easily accessible location.

1.9 Training, Certificates and Operator Cards

- A. Subcontractor is responsible for providing training records (when required by the Contractor) and competent person designation for employees who will be overseeing Quality and Safety activities on site.
- B. Crane operators must be certified by an accredited body, such as NCCCO.
- C. Operators must have adequate training for the equipment being used. Where required by state law, equipment operators must be certified.

1.10 Accident Reporting

In the event of an accident or incident, the Subcontractor must immediately notify the Contractor in accordance with the Subcontractor's RMP. Within 2 working days of any reportable accident/incident or as otherwise set out within the RMP if an earlier time is specified, the Subcontractor must complete and submit to the Contractor a written Accident Report. This report must include at minimum the following information:

1. Name, telephone, and location of entity.
2. Project name and description.

3. Name and title of person reporting.
4. Location of accident/incident.
5. Brief summary of the accident/incident giving pertinent details including type of operation ongoing at the time of the accident/incident.
6. Cause of the accident/incident, if known.
7. Casualties (fatalities, disabling injuries).
8. Details of any existing hazard (chemical, contamination, workplace safety).
9. Estimated property damage.
10. Nature of damage, effect on Subcontract schedule.
11. Action taken by Subcontractor to ensure safety and security.
12. Witness information/FAA personnel contacted.

1.11 Spills

In the event of a spill, the Subcontractor must take immediate action to control and contain the spill. This will include, at a minimum, the following actions:

1. Keep unnecessary people away, isolate hazardous area, and deny entry.
2. Do not allow anyone to touch spilled material.
3. Stay upwind; keep out of low areas.
4. Keep combustibles away from the spilled material.
5. Use water spray or foam to reduce vapor or dust generation, as needed.
6. Take samples for analysis to determine that clean-up is adequate. Properly trained personnel should be involved in this action.
7. Take other appropriate actions as needed.
8. For solid spills, immediately remove and place contaminated materials into staging piles and cover; identify the pile as contaminated; test the material for treatability; dispose of the contaminate off-site at an approved disposal facility.
9. For liquid spills, immediately absorb with sand, clean fill, or other absorbent/spill mixture.

1.12 Permit-Required Confined-Space Program

- A. Subcontractor must be required to evaluate all potential confined spaces as contained in this project and must submit a Permit Required Confined Space (PRCS) Program to the PM with a copy to the RE for review. The Contractor considers all confined spaces as permit required and therefore the Subcontractor must submit a PRCS Program for review. The PRCS Program must outline all potential confined spaces and must be made in accordance with the applicable OSHA Standards. The PRCS Program must be sent to the PM as a submittal with a copy to the RE and must be in accordance with Section 01 33 00, Submittal Procedures of the Subcontract.
- B. Permits are required to enter all FAA confined spaces. The Subcontractor must prepare an application for permit that defines all conditions that must be met in order to ensure safety of personnel. Permits must be filled out, submitted, reviewed, and posted prior to any personnel entering the confined space. Subcontractor must be required to permit all confined spaces. Prior to preparing the permit, the Subcontractor must obtain permission to permit the space from the Contractor. The Contractor will coordinate all applications with the FAA Systems Management Office (SMO) Confined Space Coordinator. See applicable OSHA Standards for additional information. At no time will the Subcontractor enter a FAA-owned confined space without first obtaining permission from the FAA through the Contractor.

- C. Copies of all confined space permits must be given to the RE and the SMO Confined Space Coordinator.
- D. Subcontractor must provide all test equipment, personal protective equipment and materials as required for the testing, permitting, monitoring, and entering of confined spaces. All equipment must be calibrated within the last 6 months and must be authorized for its intended use. Subcontractor must submit test equipment most recent calibration date to RE and the SMO Confined Space Coordinator on all test equipment used for confined spaces as part of its PRCS.
- E. Subcontractor must provide one set of all test equipment, personnel protective equipment and materials required for the RE. All items must be given to the RE at the beginning of the project. They will be returned when the project is complete. Subcontractor s must also include its PRCS Program adequate protection for the RE. The PRCS must include all ventilation, testing, monitoring, rescue equipment, ladders, and harnesses as required. All protection and testing for the RE must be as required for all Subcontractor employees.
- F. All manholes and handholes greater than 3'-6" in depth must be considered as permit-required confined spaces. Subcontractor must adhere to all requirements as outlined herein.

1.13 Fatigue Management

- A. The subcontractor must develop a Fatigue Risk Management Plan (FRMP) to prevent and manage worker fatigue.
- B. FRMP must address how during continuous operations for seven days a week, a work schedule can be structured to provide the required rest. Documentation must be maintained to show compliance with the FRMP. The FRMP must, at a minimum contain the following:
 - 1. A mandatory requirement of 2 consecutive days off for every four consecutive weeks worked.
 - 2. No more than fourteen hours worked total per 24-hour day or extended shift.
 - 3. Minimum of eight hours off between shifts.
- C. The FRMP should address worker training, recognizing fatigue symptoms, work scheduling, travel, prolonged or intense mental and/or physical activity.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 35 29

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 General

This section specifies requirements for quality control of the Work including, but not limited to, certificates of compliance, inspections and testing by the Subcontractor, and surveillance by the Contractor.

1.2 Subcontractor's Risk Management Plan

A. Subcontractor's RMP must identify Subcontract quality requirements for each activity and describe how Subcontractor intends to furnish control testing, certifications, and records to provide quality Work. The RMP must include procedures verifying equipment, workmanship, fabrication, construction, operations, and inspections comply with the Contract Documents. Minimum RMP requirements are as follows:

1. Name, resume, authority, and responsibility of QC Representative responsible for monitoring the quality of construction activities who will be on-site at all times.
2. List of outside organizations including testing laboratories, architects, or consulting engineers that will be employed by the Subcontractor. Include a description of services to be provided.
3. List of definable features of work that have distinct and separate control requirements.
4. An inspection and test plan keyed to the construction schedule, following the order of the specification technical sections, indicating which inspections and tests will be performed, the names of persons responsible for the inspection and testing of each segment of work, and the time schedule and frequency for each inspection and test.
7. Subcontractor's procedure by which to identify, segregate, disposition, and correct nonconforming product and services.
8. Subcontractor's procedure for initiating requests, control, and implementation of changes to the Subcontract's scope of work, specifications, or requirements.

B. The Subcontractor's RMP must address the inspection process for each definable feature of work (DFOW) that includes: hold points, inspections and tests, follow-up inspections, and final inspections. Minimum requirements are as follows:

1. Subcontractor must develop checklists to document inspection and test process for each DFOW. The checklist must cross reference the requirements in the technical specifications.
2. A copy of the completed checklists must be posted on the Contractor provided website on a weekly basis. If no access is available, access will be given to the PM or RE.

1.3 Contractor Quality Monitoring

- A. Contractor may perform such inspections, test, and monitoring as necessary to determine or verify Subcontractor's compliance with Subcontract requirements. Subcontractor must provide such facilities and assistance for Contractor monitoring as may be reasonably required and must ensure that all quality control records and places of Work are open and available to Contractor. Contractor's monitoring activities may consist of review, observation, inspection of Subcontractor

personnel, material, equipment, processes, and test results including off-site inspections. Contractor may perform quality audits of records and performance of Subcontractor or its lower tier subcontractor and suppliers. The Subcontractor, lower tier subcontractor or supplier being audited must be available during the audit as required by the Contractor. Testing or inspecting by the Contractor or FAA does not relieve the Subcontractor or its subcontractors from performing Work according to Subcontract requirements.

- B. The PM or RE will notify Subcontractor of any detected non-compliance with the requirements of this Section or other technical specification sections. Such notice, when delivered to Subcontractor at the Work site, must be deemed sufficient for the purpose of notification. Subcontractor must take immediate corrective action after receipt of a non-compliance notice and maintain a detailed record of every non-compliance and corrective action taken. The Subcontractor must make no part of time lost due to non-compliance and/or stop orders the subject of a request for extension of time or compensation. Cost incurred by Contractor or FAA to correct defective work will be deducted from the total amount due the Subcontractor.

1.4 Quality Reports

Subcontractor must provide forms to be used in conjunction with RMP reporting. A copy of all forms must be included with the RMP. The following requirements are listed for specific reports:

- A. Test Reports. Subcontractor must be responsible for establishing a system that will record all tests results. Information on test designation, location, date of test, specification requirements, results and retest results, causes for rejection and recommended remedial actions must be documented. A copy of test results must be sent directly from the agency performing the testing services to PM or RE. A copy of any failing report must be sent immediately. All test reports provided by a testing agency must be reviewed and signed by a competent, qualified individual in the related discipline of the test subject matter.
- B. Construction reports. Subcontractor must submit duplicate copies to RE by 9:00 a.m. on the business day following day of report. At a minimum, daily construction reports must include the following information:
 1. List of subcontractors at the site.
 2. List of separate contractors at the site.
 3. Approximate count of personnel at the site.
 4. High and low temperatures, general weather conditions.
 5. Accidents.
 6. Meetings and significant decisions.
 7. Unusual events.
 8. Stoppages, delays, shortages, losses.
 9. Meter readings and similar recordings.
 10. Emergency procedures.
 11. Orders and requests of governing authorities.
 12. Change Orders received, implemented.
 13. Services connected, disconnected.
 14. Equipment or system tests and start-ups.
 15. Partial Completions/Occupancies.
 16. Substantial Completions authorized.
 17. Number of days used in the Subcontract period to date.

1.5 Record Drawings

The QC Representative must ensure the Record Drawings required by the Subcontract are scalable, kept current on a daily basis, and marked to show deviations from the Contract drawings. QC Representative must ensure each deviation has been identified with appropriate modifying documentation such as RFI or FI number, and date.

1.6 Inspections and Testing Laboratory

All inspections and testing on and off Site required by the Subcontract must be performed as specified in individual specification sections by a certified independent firm employed by the Subcontractor at Subcontractor's expense. Inspecting, testing, and source quality control may occur on or off the Site. Subcontractor must submit qualifications and certifications of the independent inspections and testing firm for Contractor approval. Subcontractor must submit testing reports by the independent firm to the PM and RE, in duplicate, indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents. Subcontractor must furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested. Any retesting required because of nonconformance to specified requirements must be performed by the same independent firm at Subcontractor's expense.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 45 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 General

This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security, and protection.

1.2 Temporary Utilities and Support Facilities

- A. Temporary utilities required include but are not limited to:
 - 1. Electric power and light.
- B. Temporary construction and support facilities required include but are not limited to:
 - 1. Sanitary facilities, including drinking water.
 - 2. Temporary enclosures.
 - 3. Waste disposal services.
 - 4. Construction aids and miscellaneous services and facilities.
- C. Security and protection facilities required include but are not limited to:
 - 1. Temporary fire protection.
 - 2. Barricades, warning signs, lights.

1.3 Contractor Responsibilities

- A. Contractor must make all reasonable required amounts of utilities available to the Subcontractor from existing outlets and supplies to the extent allowed by the Government. Unless otherwise provided in the Subcontract, the amount of each utility service consumed must be charged to or paid for by the Subcontractor at prevailing rates charged to the Government or at reasonable rates determined by the Contractor. The Subcontractor must carefully conserve any utilities furnished without charge.
- B. The Subcontractor, at its expense and in a workmanlike manner satisfactory to the Contractor must install and maintain all necessary temporary connections and distribution lines and all meters required to measure the amount of each utility used. Prior to final acceptance of the work by Contractor, the Subcontractor must remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

1.4 Subcontractor Responsibilities

- A. The Subcontractor must confine all operations (including storage of materials) to areas set out in the Subcontract or otherwise authorized or approved by the Contractor.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Subcontractor only with the approval of the PM and must be built with labor and materials furnished by the Subcontractor without expense to Contractor. The temporary buildings and utilities must remain the property of the Subcontractor and must be removed by the Subcontractor at its expense upon completion of the Work. With the written consent of the SA, the buildings and utilities may be abandoned and need not be removed.

- C. The Subcontractor must use only established roadways, or when authorized by the Contractor, temporary roadways that may be constructed by the Subcontractor at the Subcontractor expense. When materials are transported during execution of the Work, vehicles must not be loaded beyond the loading capacity of the vehicle or as prescribed by any laws or regulation. When it becomes necessary to cross curbs or sidewalks, the Subcontractor must protect them from damage; and must repair or pay for the repair of any damaged curbs, sidewalks, or roads.

1.5 Temporary Utility Installation

- A. The Subcontractor must provide, maintain, and remove temporary electrical power, drinking and project water, and sanitary facilities as necessary for the proper and expeditious execution of work. If these facilities are not available on-site for use by the Subcontractor, then these facilities must be installed and maintained to comply with all federal, state, and local regulations governing such installations.
- B. Locations of such facilities will be approved by the RE.
- C. Subcontractor must provide and pay for all temporary services and facilities as specified herein and as necessary for the proper and expeditious execution of the Work.
- D. Subcontractor must make, or have made, all connections to existing services and sources of supply as necessary and/or indicated and pay all charges for same.
- E. Subcontractor must provide all labor, materials, equipment, and appurtenances necessary for the complete installation, operation and maintenance of all temporary service systems and facilities.
- F. All Work under this Section must comply with applicable laws, rules, regulations, codes, ordinances and orders of all federal, state and local authorities having jurisdiction for the safety of persons, materials, and property.

1.6 Temporary Water

Subcontractor must arrange to transport all necessary water for construction and drinking purposes in accordance with CFR 29 Part 1926, Subpart D.

1.7 Temporary Toilets and Sanitation

Subcontractor must provide ample and suitable on-site sanitary conveniences with proper enclosures and hand washing facilities in accordance with CFR Part 1926, Subpart D for the use of the workers employed on the Work. Temporary toilets must be properly maintained and serviced on a regular basis. Secure temporary toilets to prevent possible overturning.

1.8 Temporary Electric Lighting and Power

- A. Subcontractor must provide and maintain a temporary lighting and power system in accordance with CFR 29 Part 1926 Subpart K for construction and inspection purposes.
- B. Subcontractor must make all necessary arrangements for temporary electrical services with the local power company to provide and pay for all temporary work or, at Subcontractor's option, provide an approved temporary engine generator at the project site for construction support.
- C. Subcontractor must not be permitted to use FAA-furnished electrical service for installation of the work specified.

1.9 Temporary Heat

- A. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Maintain minimum 50-degree F ambient temperature in enclosed areas where construction is in progress.

1.10 Temporary On-Site Communications

The Subcontractor may provide on-site communications with hand-held radios. Coordinate with the PM or RE and verify frequencies used do not interfere with local operations.

1.11 Temporary Access

- A. The Subcontractor must provide, maintain, and remove temporary roads necessary for access to the Worksites. These access roads must be obliterated at the conclusion of the work and the areas must be protected against erosion and must be reseeded.

1.12 Barricades, Warning Signs, and Hazard Markings

- A. Subcontractor must furnish, erect, and maintain all barricades, warning signs and markings for hazards to protect the Work.
- B. When used during peak periods of darkness, such barricades, warning signs and hazard markings must be suitably illuminated (open flame type lights are not permitted).
- C. Once erected, Subcontractor must maintain barricades, warning signs and markings for hazards until their dismantling is directed by the RE or PM.

1.13 Temporary Construction Support Facilities

Not used.

1.14 RE Field Office Description

Not used.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 General

This section covers Subcontractor's requirements regarding materials and equipment that are incorporated into the Work.

1.2 Materials and Equipment Incorporated into Work

- A. Material and equipment incorporated into the Work must conform to applicable specifications and standards and must comply with size, make, type and quality specified, or as specifically approved in writing by the PM. Manufactured and fabricated products must be designed, fabricated, and assembled in accordance with the best and current engineering and shop practices. Like parts of duplicate units must be manufactured to standard sizes and gauges and must be interchangeable. Two or more items of the same kind must be identical and manufactured by the same manufacturer.
- B. Products must be suitable for service conditions. Equipment capacities, sizes and dimensions shown or specified must be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose other than for which it is designed or specified. Furnish and install products specified. Other makes or brands may be used as outlined under options and conditions for substitution stated in this section.

1.3 Manufacturer's Instructions

- A. When Contract Documents require that installation of Work must comply with manufacturer's printed instructions, copies of such instructions must be distributed to parties involved in the installation including the RE with copies to the PM. The Subcontractor must maintain one set of complete instructions at the Worksite during installation and until completion.
- B. Products must be handled, installed, connected, cleaned, and conditioned in strict accordance with such instructions and in conformity with specified requirements. If job conditions or specified requirements conflict with manufacturer's instructions, the Subcontractor must consult with the RE for further instructions. All work must be performed in accordance with manufacturer's instructions. No preparatory step or installation procedure must be omitted unless specifically modified or exempted by contract documents.

1.4 Transportation and Handling

- A. Products must be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments must be inspected to ensure compliance with requirements of the Contract Documents and approved submittals. Ensure that products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.
- B. Delivery of Subcontractor-Furnished Materials. The Subcontractor must have personnel at the project site to receive all material being shipped by delivery vehicles. Contractor or FAA personnel are not responsible for signing off on deliveries of Subcontractor-Furnished

Material. Delivery of Subcontractor-furnished material must not be accepted by any Federal Government personnel.

1.5 Storage

The Subcontractor is responsible for arranging local storage areas for Government and Subcontractor Furnished Materials. Storage areas on facility property must be coordinated through the Airport Authority or facility. Products must be stored in accordance with manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements must be stored in weather-tight enclosures. Temperature and humidity must be maintained within the ranges required by the manufacturer's instructions. Fabricated products must be stored above the ground, on blocking or skids to prevent soiling or staining. Products that are subject to deterioration must be covered with impervious sheet coverings and adequate ventilation must be provided to avoid condensation. Loose granular materials must be stored in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.6 Proprietary Names

Whenever proprietary names are used in this specification for material or equipment, such names must be construed as a standard to establish quality and accurately define the material or equipment. Another make or item may be approved by the Contractor provided it is equal or better than the specified manufacturer. All materials and equipment that is Subcontractor furnished material must meet or exceed the specified salient characteristics.

1.7 Substitutions

- A. A separate request for each substitution must be submitted. Each request must be supported with complete data substantiating compliance of proposed substitution with the requirements stated in the Contract documents. Each request must include product identification, manufacturer's literature including address, product description, reference standards and performance, and test data. Samples must be submitted as applicable.
- B. Substitution Information. An itemized comparison of the proposed substitution with the product specified must be included. The following information must also be included: data relating to changes in the construction schedule; list of changes required in other work or products; and accurate cost data.
- C. Substitution Conditions. Substitute products must not be ordered or installed without written acceptance from the PM. In making a formal request for substitution, the Subcontractor represents that it has investigated the proposed product and has determined that it is equal to or superior in all respects to that specified; that they will provide same warranties or bonds for substitutions as for product specified, that they will coordinate installation of accepted substitution into work to be complete in all respects, that they waive claims for additional costs caused by substitution that may subsequently become apparent, and that cost data is complete and includes related costs under this Subcontract.

1.8 Safety Data Sheets

- A. The Subcontractor must submit a chemical inventory as part of their RMP and have available on the jobsite Safety Data Sheets (SDS), Department of Labor Form OSHA-174, as prescribed in Federal Standard No. 313, latest edition, for hazardous material five (5) business days before delivery of

the material, whether or not listed in Appendix A of the Standard. This obligation applies to all materials delivered under this contract which will involve exposure to hazardous materials or items containing these materials. "Hazardous Materials", as used in this paragraph, is as defined in Federal Standard No. 313, latest edition.

- B. The RE, during construction, will routinely check products utilized on site by the Subcontractor to ensure SDSs are available onsite and the chemical inventory is updated as needed.
- C. The subcontractor or lower tier subcontractor must provide any specialty PPE needed to handle materials brought on site as defined by the SDS.

1.9 Asbestos-Free and Lead-Free Material

The Subcontractor must provide to the SA a signed statement stating that to the best of its knowledge, no asbestos-containing or lead-containing materials were used during the construction of this project. If the Contractor suspects the presence of asbestos, the Contractor will sample the suspect material to verify that no asbestos-containing material was utilized. If asbestos-containing material is subsequently found during sampling of the materials, the Subcontractor must remove and replace the product or material at its expense. In addition, the Subcontractor must incur the costs of the original testing and/or any retesting that may be necessary.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 60 00

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 GENERAL

1.1 General

This section covers the requirements of Subcontractor to provide construction layout resources for all required horizontal and vertical control work related to the Work.

1.2 Layout of Work

- A. The Subcontractor must layout its work from established baselines and benchmarks indicated on the drawings and must be responsible for all measurements in connection with the layout. The Subcontractor should furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the Work. The Subcontractor will be responsible for the execution of the Work to the lines and grades that may be established or indicated by the RE. The Subcontractor must also be responsible for maintaining and preserving all stakes and other marks established by the Contractor until authorized to remove them. If such marks are destroyed by the Subcontractor or through its negligence before their removal is authorized, the Contractor may replace them and deduct the expense of the replacement from any amounts due or to become due to the Subcontractor.

1.3 Types of Layout

- B. The Subcontractor must furnish surveying resources to accomplish the work listed below.
 1. Layout and staking of the facilities.
 2. Layout of all access roads, plots, and miscellaneous foundations in accordance with the Contract drawings.
 3. Survey all cable runs, junctions, and turns.

1.4 Materials, Equipment, and Personnel

- A. All materials used for surveying must be obtained from a dealer regularly engaged in the sale or rental of surveying supplies. Contractor-fabricated hubs and general construction nails must not be used for surveying purposes.
- B. All surveying equipment that is used must be in proper working condition. The date of the last calibration must be provided to the RE upon request. If a surveying tape is used, it must be free of kinks and tears.
- C. The surveying personnel used by the Subcontractor must be experienced and familiar with the type of equipment being used. The Subcontractor must provide resumes of the survey crew party chief and instrument operator if requested by the RE. Failure by the Subcontractor to furnish competent survey personnel may result in the Contractor duplicating the required survey work until acceptable to the RE at no cost to the Contractor.

1.5 Examination

Any record furnished is for information only and does not represent all conditions that may exist. Other construction, of which no records are available, may be encountered. The Subcontractor and each subcontractor must field-verify existing dimensions. The existence and location of underground and other utilities and construction indicated as existing is not guaranteed.

Before beginning sitework, Subcontractor must investigate and verify the existence and location of underground utilities and other construction.

1.6 Conducting Survey Work

- A. The Subcontractor must layout its work from established airport or facility base lines and benchmarks and/or as indicated on the drawings. Subcontractor will be responsible for all measurements in connection with the layout. The Subcontractor must furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to layout any part of the Work. The Subcontractor will be responsible for the execution of the Work to the lines and grades specified in the Contract Documents or as indicated by the RE. The RE reserves the right to determine when a reference hub has been displaced.
- B. The Subcontractor must establish and maintain a minimum of two permanent benchmarks on the Worksite, referenced to data established by survey control points, and record benchmark locations with horizontal and vertical data on project Record Documents.
- C. The Subcontractor must preserve and maintain all stakes and other marks established by the RE until authorized to remove them. If such marks are destroyed by the Subcontractor or through its negligence before removal is authorized, the Contractor may replace them and deduct the expense of the replacement from any amounts due or to become due to the Subcontractor.
- D. The Subcontractor must establish the horizontal control for the system layout, access roads, facility plot, foundations, and light stations. All cable runs must be marked at a minimum of 200-foot stations, at all turns, and at all junctions or hand holes. The distance from the centerline of any adjacent runway to the cable run must be determined and recorded on the Record Drawings if such dimensioning is shown on the Contract Drawings.
- E. Prior to foundation installation, the Subcontractor must take elevation readings for the existing grade. Following installation of all light stations, the Subcontractor must take elevation readings of the tops of concrete foundations and light elevations, at all light stations. Subcontractor must record all elevation readings on the Record Drawings.

1.7 Quality Assurance

The RE reserves the right to verify all survey work. The Subcontractor must leave all survey hubs in place until work has been verified by the RE. If deemed necessary, the Subcontractor must supply one laborer to assist the RE in verifying all survey work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 71 23

SECTION 01 71 33 - PROTECTION OF ADJACENT CONSTRUCTION

PART 1 GENERAL

1.1 General

This section covers the basic care the Subcontractor must use to prevent unnecessary damage to property in or near the Worksite during performance of the Work.

1.2 Protection of Existing Vegetation, Structures, Equipment, and Facilities

- A. The Subcontractor must take all precautions necessary to protect the existing facilities, equipment, buildings, and vegetation during construction. Any areas damaged must be repaired or replaced at no additional cost to owner. Repairs must be approved by the RE. All repairs must match the original finish and be made utilizing materials equal in quality to the existing.
- B. The Subcontractor must preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which is not to be removed, and which does not unreasonably interfere with the work required under this contract. The Subcontractor must only remove trees when specifically authorized to do so and must avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during Subcontract performance, or by the careless operation of equipment, or by workmen, the Subcontractor must trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the RE.
- C. The Subcontractor must protect from damage all existing improvements and utilities at or near the Worksite and on adjacent property of a third party, the locations of which are made known to or should be known by the Subcontractor.
- D. The Subcontractor must 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 Subcontract or failure to exercise reasonable care in performing the Work. If the Subcontractor fails or refuses to repair the damage promptly, the Contractor may have the necessary work performed and charge the cost to the Subcontractor.

1.3 Property Protection

- A. The Subcontractor must construct and maintain such temporary fences, gates and other facilities as must be necessary for preservation of crops, control of livestock, and protection of property. Before cutting a fence, the Subcontractor must take necessary precautions to prevent the straying of livestock and may prevent the loss of tension in or damage to adjacent portions of the fence. The Subcontractor must immediately replace all fencing and gates that it cuts, removes, damages, or destroys with new materials to the original standard, with the exception that undamaged gates may be reused.
- B. The Subcontractor must comply with the request of the property owner relative to leaving gates open or closed.
- C. The Subcontractor must use all necessary precautions to avoid the destruction of surveying markers such as section corners, witness trees, property corners, mining claim markers, bench markers, triangulation stations, and the like. If any such marker must be destroyed, the Subcontractor must first notify the agency responsible

for the marker, as well as the RE, and assume all responsibility for replacing markers.

- D. Unnecessary damage is that which can be avoided through efficient and careful performance of the work in a careful manner, considering the land rights which have been secured. If the Subcontractor damages any property, the Subcontractor must at once notify the RE and owner or custodian and may make or arrange to make prompt and full restitution.
- E. Maps and specifications provided by Contractor may not give the location of all water supply, drainage, irrigation, and other underground facilities. Prior to entering a tract of land for subcontract purposes, the Subcontractor must ascertain from the property owner or other reasonably available source the location of any irrigation system, domestic water system, source of water, and drainage system existing on the property, whether serving that property or other property. The Subcontractor must report any findings to the RE. The Subcontractor must avoid damaging or obstructing these facilities or polluting water supplies.
- F. The Subcontractor must hold Contractor harmless from any and all suits, actions, and claims for damages, including environmental impairment, to property arising from any act or omission of the Subcontractor, its subcontractors, or any employee of the Subcontractor or subcontractors, in any way related to the Work or operations under this Subcontract.
- G. The Subcontractor must indemnify and hold harmless the property owners or parties lawfully in possession against all claims or liabilities asserted by third parties, including all governmental agencies, resulting directly or indirectly from the Subcontractor's wrongful or negligent acts or omissions.
- H. The Subcontractor must maintain all roads used by it, and upon completion of the job must leave them in as good a condition as when first used. A road-grading machine, not a bulldozer, must be used for maintenance and final grading. The Subcontractor must not interfere with the property owner's use of roads existing prior to the Subcontractor's entry.

1.4 Management and Disposal of Hazardous Wastes

- A. The management and disposal of hazardous wastes and materials exposes the Subcontractor, Contractor, and FAA to short and long-term liabilities. In order to reduce these potential liabilities, it is critical that the Subcontractor be fully aware of the hazards and regulatory requirements associated with the hazardous materials involved in this project. Only qualified personnel must be used in their handling and transportation. Before commencing work, the Subcontractor must:
 - 1. Perform an environmental assessment of the work required under the contract identifying tasks which involve the use, handling or transportation of hazardous materials or wastes.
 - 2. Submit an environmental management plan identifying and dealing with each specific task involving the wastes. The plan must be specific enough to demonstrate a thorough understanding of the environmental risks and the appropriate methodology for dealing with them. The plan must also list the required permits and reference the relevant regulations which govern the activities involved in dealing with the materials or wastes.

3. Meet with representatives of the Contractor during the preconstruction conference to discuss and to develop a mutual understanding on implementation of the plan.
4. The Contractor may require other tasks to be added to the plan. If planned methodologies for dealing with the risks are deemed insufficient, the PM may require revision. Work involving hazardous materials or wastes must not commence until adequate plans have been submitted and reviewed. Contractor's review of the Subcontractor's plan does not relieve the Subcontractor of its liability for environmental law and regulatory compliance.

1.5 Protection of Installed Work

- A. Protect installed Work. Provide special protection where required in the Specifications and drawings or under manufacturer's warranty.
- B. Provide temporary and removable protection for installed Products. Control activities in immediate Work area to prevent damage.
- C. Protect finished floors and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- D. Prohibit traffic or storage upon completed surfaces. Obtain protection instructions from the manufacturer if traffic or activity is necessary.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 71 33

SECTION 01 74 00 - CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.1 General

This section sets out the basic Subcontractor requirements for maintaining an orderly and clean Worksite.

1.1 Basic Requirements

- A. The Worksite, including storage areas, must be kept clean and orderly during progress of the work. The Subcontractor will be personally responsible for the storage of tools, equipment, and materials. The Subcontractor must require each lower tier subcontractor engaged upon the work to bear full responsibility for cleaning up during and immediately upon completion of their work.
- B. The Subcontractor must provide on-site containers for the collection of waste material, debris and rubbish and periodically remove as required or at the direction of the RE. Onsite waste containers must be placed in areas coordinated with local site representatives to allow for proper exclusion zones and access. Any spillage on access or haul routes must be cleaned up immediately. All spoil, waste, or debris removed from the work site and not specified for reuse or identified as salvageable items, must become the property of the Subcontractor, and must be disposed of off-site in areas authorized by the applicable County, State and/or Local agencies and in accordance with current rules and regulations governing the disposal of such waste. Disposal fees and miscellaneous charges will be paid by the Subcontractor.
- C. Unless specifically set forth in the Subcontract, burning is not permitted for the disposal of refuse and debris. All rubbish, waste, tools, equipment, and other apparatus caused by or used in the execution of the Work must be removed. This will in no way be construed to relieve the Subcontractor of its primary responsibility for maintaining the facilities and the site clean and free of debris, and leaving all work in a clean and proper condition acceptable to the RE.
- D. Immediately after unpacking, all packing material, case lumber, wrappings, or other rubbish, flammable or otherwise, must be collected and removed from the building and the premises.
- E. Subcontractor must contain material and debris to prevent it from entering aircraft operations areas.

1.2 Progress Cleaning and Waste Removal

- A. Remove all rubbish, waste, tools, equipment, and appurtenances used from the worksite at the end of each day to maintain egress, safety, and sanitation.
- B. Remove debris and rubbish from closed or remote spaces before enclosing the space. Collect and remove waste materials, debris, and rubbish from site, and dispose of off-site.
- C. Sweep and vacuum clean interior areas before start of surface finishing and continue cleaning daily to eliminate dust.

1.3 Overall Cleaning

Immediately before the final inspection, the entire exterior and interior of any building and the surrounding areas must be thoroughly cleaned by the Subcontractor, including but not limited to the following:

- A. All construction facilities, debris, and rubbish must be removed from any building and the site.
- B. All finished surfaces within any building must be swept, dusted, vacuumed, washed, or polished as required.
- C. All tools, scaffolding, temporary utility connections or buildings, belonging to the Subcontractor, or used under his/her direction, must be removed from the site.

1.4 Final Cleaning

- A. Thoroughly clean entire worksite and exterior and interior of any building.
- B. Remove debris and rubbish from any building and the worksite.
- C. Finished surfaces within any building must be swept, dusted, vacuumed, washed, or polished as required.
- D. Remove all tools, scaffolding, temporary utility connections or buildings belonging to the Subcontractor and its lower tier subcontractors from the site.
- E. Reseed disturbed areas. Rake and restore all gravel surfaces.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION 01 74 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 General

This section sets out the requirements for Subcontract closeout at completion of the Work.

1.2 Final Submittal Requirements

Prior to final acceptance, the Subcontractor must assemble all appropriate warranties, product information, certifications, equipment installation instructions, SDS sheets, and the results of all tests.

1.3 Completion Certificate

When Subcontractor considers the Work completed, Subcontractor must submit a signed certification in the form provided by the SA certifying the following:

- A. Contract Documents have been reviewed and Work inspected for compliance with Subcontract, including Punchlist Work, and accepted by the FAA.
- B. All materials used in the project are asbestos and lead free.
- C. Record Documents, As-Builts, final project photographs, damage or settlement survey, property survey, Record Drawings and similar final record information as required and acceptable to PM have been submitted by Subcontractor.
- D. Equipment/systems have been tested in the presence of RE and are operational.
- E. Required operational, and maintenance manuals, data and parts list have been submitted and approved.
- F. Spare parts have been provided as required.
- G. Warranties and guarantees have been prepared and found acceptable to SA.
- H. Work is completed, premises cleaned and ready for inspection, temporary facilities and services have been removed, and pre-existing conditions have been restored.
- I. All maintenance personnel have been properly instructed in the use of the facilities and all installed equipment as required by the Contract Documents.
- J. Subcontractor has released all property installed in the performance of the Subcontract and all GFE/GFP not used has been transferred to the Contractor and delivered to place of origin.
- K. All identification badges and keys issued for the Project have been returned.

1.4 Pre-Contractor Acceptance Inspection (CAI) Punch List Walk

- A. The RE will furnish the Subcontractor with a list of discrepancies in the work, material, and equipment (punch list) that were noted before scheduling the CAI with the government. Subcontractor must correct all deficiencies, if any, detected during the pre-CAI walk before the CAI can be scheduled and the final acceptance of the product is approved during

the CAI. Work showing evidence of substandard performance will not be accepted and must be corrected by the Subcontractor at its own expense.

- B. The Subcontractor must coordinate with the RE to schedule the pre-CAI punch list walk. The Subcontractor must notify the RE in the field at least 3 working days in advance that they are ready for the pre-CAI punch list walk.
- C. The Subcontractor must have the superintendent present at the pre-CAI punch list walk. The RE will conduct an inspection of the facility to verify all Subcontract conditions are met. Any additional required test results must be submitted to the RE at this time.

1.5 Contractor Acceptance Inspection

- A. Upon acceptance of the clearance of any punch list items, the RE will coordinate the CAI with the appropriate FAA personnel. The subcontractor's superintendent must be on site during the CAI.
- B. If there are FAA CAI discrepancies related to the subcontract documents identified by the FAA, the subcontractor must correct those discrepancies before leaving the project.

1.6 Final Acceptance of Work

- A. The Subcontractor must correct discrepancies noted on the punch list and discrepancies identified by the FAA during the CAI prior to final acceptance. The premises must be thoroughly clean prior to final CAI with the government.
- B. Upon acceptance by Contractor, and the Government, Subcontractor may submit Final Application for Payment.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION 01 77 00

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**SECTION 02 41 31
SELECTIVE SITE DEMOLITION**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Work Includes:

This work includes the demolition and removal of items designated for removal on the drawings, including disconnecting, demolition, removal, and capping of identified utilities.

1.1.2 Maintaining Normal Activities During Construction:

Normal activities within the facility will continue during construction.

1.1.3 Recycling or Disposal:

All demolition material must be legally and properly recycled or disposed of off-site.

1.1.4 Explosives or Burning:

The use of explosives or burning is not permitted at any time.

1.1.5 Demolition Items:

Items for demolition include, but are not necessary.

1.1.5.1 Demolition, Removal, Recycling, and Burial:

Demolition, removal, and recycling of existing towers, tower foundations, guywires and their anchors, domestic water pipe, and direct bury coaxial cables. Coordinate outages with Parsons RE and FAA.

1.1.5.2 Selective Wall Demolition:

Selective demolition of existing building wall for new conduit penetrations.

1.2 SUBMITTALS

SD-01 Preconstruction Submittals

Demobilization Plan: Submit description of, sequencing of, and anticipated quantities of demolition items designated as recycle, reused inventory, demolition, and disposal to the RE for approval before demolition begins. Procedures must provide for careful removal and disposition of materials specified to be retained and relocated. Submit demolition schedule with the Demolition Plan.

Photographs Or Video, sufficiently detailed, should be taken of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

Waste Management Plan Prior to any waste removal, submit a Waste Management Plan for review and approval. The plan must include the

following:

Designate the party who will implement the plan,

Analysis of the estimated job-site waste to be generated,

Separation and storage requirements necessary to prevent contamination,

Recycling facility name, contact information, facility requirements for acceptance, and estimated tip fee and/or rebate for each material,

Disposal facility name, contact information, facility requirements for acceptance, and estimated tip fee and/or project cost of waste,

Description of transport means and cost of transportation, and

Overall percentage of material to be diverted from the landfill.

1.3 QUALITY ASSURANCE

1.3.1 Pre-Installation Meeting:

Convene pre-installation meeting one (1) week prior to beginning of work of this section to verify project requirements, review installation and substrate conditions, and coordination with all subtrades.

1.4 DELIVERY, STORAGE AND HANDLING

Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Parsons and at no cost to Parsons.

PART 2 PRODUCTS

2.1 PRODUCTS

Provide all materials and equipment required for temporary or permanent construction as required for the proper execution of the work on this section.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Demolition Plan:

Submit a demolition plan to Parsons identifying sequence, description, and recycling/disposal of items to be demolished. Demolition plan must include (as applicable) but not be limited to:

3.1.1.1 Permits

3.1.1.2 Safety Procedures (PPE, trained equipment operators, safety zone designation, etc.)

3.1.1.3 Site Preparation

3.1.1.4 Traffic Routing Plan

3.1.1.5 Daily Housekeeping, Recycling, Disposal and Debris Removal

3.1.2 Demolition and Removal:

Demolition and removal must be performed with care so as to create the least possible damage to the supporting and surrounding surfaces. Damaged surfaces must be repaired or restored, at a minimum, to their original condition.

3.1.3 Demolition Performance:

Perform demolition in such a manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, structures or services; and to provide free passage to and from such adjacent areas.

3.1.4 Material and Equipment Removal and Storage:

Carefully remove and store materials and equipment listed for reuse or relocation to prevent damage and reinstall as the work progresses.

3.1.5 OSHA Compliance:

Comply with OSHA requirements.

3.1.6 Safeguards:

Provide safeguards, such as cones, barricades, signs and other similar items that are required for the protection of all personnel during demolition and removal operations.

3.1.7 Foreign Object Debris (FOD) Prevention:

Prevent the spread of flying particles, dust and debris outside of the immediate work area. To prevent dust on the electronic equipment, install plastic sheeting around any interior areas to be cut and implement the use of a HEPA vacuum to remove dust and debris during any cutting or drilling operations. Subcontractor is responsible for control of any dust or debris that is generated during penetration operations. Interior areas must be cleaned immediately after the demolition operation.

3.1.8 Firewatch:

Wherever a cutting torch or other equipment that might cause a fire is used, provide a firewatch and fire extinguishers nearby ready for immediate use. All workers must be instructed in the use of fire extinguishers. A Hot Work Permit will be required for any work that may cause a fire hazard.

3.2 DISPOSAL AND RECYCLING

3.2.1 Disposal:

All materials and debris resulting from demolition, and not specified in Paragraphs 3.3.2 and 3.3.3, must be disposed of off-site and in accordance with General Requirements and the applicable federal, state, and local codes. The Subcontractor must not use any of these items, including connections, supports, screws, etc., in the new installation.

3.2.2 Hazardous Material Recycling:

All metal found with regulated amounts of Lead-Based Paint or coatings must be recycled to conform with 40 CFR 261.6(a)(3)(ii)

3.2.3 Nonhazardous Material Recycling:

The following nonhazardous waste categories must be recycled:

3.2.3.1 Land-Clearing Debris

3.2.3.2 Concrete

3.2.3.3 Metals

3.2.4 Offsite Removal and Disposal:

Remove and dispose of demolition debris, not specified in Paragraphs 3.3.2 and 3.3.3, offsite daily.

3.2.5 Dumpster:

Subcontractor must provide own dumpster. Use of FAA dumpster or local airport authority dumpster is not allowed.

3.2.6 Debris and Rubbish Removal and Transport:

Remove and transport debris and rubbish in a manner that will prevent spillage. Cover the loads. If any spillage occurs, clean up immediately.

3.2.7 Recycling Location Contact Information:

Subcontractor must provide business name(s), address(es), and telephone number(s) of location where towers are to be recycled prior to start of demolition.

-- End of Section --

**SECTION 05 40 00
COLD-FORMED METAL FRAMING**

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318 (2019; R 2022) Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AISI S110 (2007; Suppl 1; Reaffirmed 2012) Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames

AISI S200 (2007) North American Standard for Cold-Formed Steel Framing - General Provision

AISI S201 (2007) North American Standard for Cold-Formed Steel Framing - Product Data

AISI S202 (2011) Code of Standard Practice for Cold-formed Steel Structural Framing

AISI S211 (2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design

AISI S212 (2007) North American Standard for Cold-Formed Steel Framing - Header Design

AISI S213 (2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design

AISI S214 (2012) North American Standard for Cold-Formed Steel Framing - Truss Design

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A370	(2024) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1003/A1003M	(2023; E 2024) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM C955	(2017) Standard Specification for Cold-Formed Steel Structural Framing Members
ASTM C1007	(2020) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM E119	(2024) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E329	(2023) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements
ASTM E1190	Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield

Strength

ASTM F1941	(2010) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F2329/F2329M	(2015; R 2023) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023; with Change 2, 2024) Structural Engineering
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1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

Recycled Content of Steel Products

SD-05 Design Data

Metal Framing Calculations

SD-07 Certificates

Load-Bearing Cold-Formed Metal Framing

Welds

1.3 DELIVERY, STORAGE, AND HANDLING

Steel framing and related accessories must be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members must have the structural properties indicated. Where physical structural properties are not indicated, they must be as necessary to withstand all imposed loads.

Design framing in accordance with AISI S100. Non-load-bearing metal framing, furring, and ceiling suspension systems are specified in Section 09 29 00 GYPSUM BOARD.

Submit mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports must be based on the results of three coupon tests in accordance with ASTM A370.

1.5 MAXIMUM DEFLECTION

Deflections of structural members must not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

For scissor roof trusses limit the horizontal deflection at supports to less than 1-1/4 inches.

1.6 QUALITY ASSURANCE

- a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.
- b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.
- c. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- d. Welding Qualifications: Qualify procedures and personnel according to the following:
 - (1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".
 - (2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
- e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
- f. AISI Specifications and Standards: Comply with:
 - (1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".
 - (2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".
 - (3) AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".
 - (4) AISI S201, "North American Standard for Cold-Formed Steel Framing

- Product Data".
- (5) AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
- (6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".
- (7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".
- (8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".
- (9) AISI S214, "North American Standard for Cold-Formed Steel Framing - Truss Design".

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories including the following:

- a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.
- b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.
- c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

Sign and seal fabrication drawings by a registered professional engineer.

1.6.2 Design Data Required

Submit metal framing calculations with design criteria and structural loading to verify sizes, thickness, and spacing of members and connections signed and sealed by a registered professional engineer. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components must comply with ASTM C955 and the following.

- a. Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.
- b. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - (1) Grade: As required by structural performance.
 - (2) Coating: G90 (Z275).

- c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: 0.0329 inch.
 - (2) Flange Width: 1-3/8 inches.
- d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: Matching steel studs.
 - (2) Flange Width: 1-1/4 inches.
- e. Roof Truss Members: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: Matching steel studs.
 - (2) Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or directly fastened construction.
- f. Floor Truss Members: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: Matching steel studs.
 - (2) Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or directly fastened construction.

2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50.

2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter

Studs and Joists of 43 mils (0.043 Inch) and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 33 33,000 psi G60.

2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties

Size and thickness as required.

2.2 MARKINGS

Studs and track must have product markings stamped on the web of the section. The markings must be repeated throughout the length of the member at a maximum spacing of 4 feet on center and must be legible and easily read. The product marking must include the following:

- a. An ICC number.
- b. Manufacturer's identification.
- c. Minimum delivered uncoated steel thickness.

- d. Protective coating designator.
- e. Minimum yield strength.

2.3 CONNECTIONS

2.3.1 Steel-To-Concrete Connections

- a. Anchor Rods: ASTM F1554, Grade 55; galvanized per ASTM A153/A153M.
- b. Post-Installed Concrete Anchors: Adhesive or expansion anchors fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
- c. Power-Actuated Fasteners: Fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC 70 greater than or equal to the design load as determined by testing per ASTM E1190 conducted by a qualified testing agency.

2.3.2 Steel-To-Steel Connections

- a. Screws: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941 or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M.
- b. Bolts: ASTM A307 coated by hot-dip process per ASTM F2329/F2329M or zinc-coated by mechanical-deposition process per ASTM B695, Class 55.
- c. Welding Electrodes: Comply with AWS standards.

2.4 PLASTIC GROMMETS

Supply plastic grommets for stud webs as recommended by stud manufacturer, to protect electrical wires and plumbing piping. Prevent metal-to-metal contact between wiring/piping and studs.

2.5 SEALER GASKET

Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to match width of bottom track on concrete slab or foundation.

PART 3 EXECUTION

3.1 TRUSS FABRICATION

- a. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
- b. Truss must be fabricated either on site or off site prior to erection.

- c. Fabricate trusses using jigs or templates.
- d. Splices can only occur at joints.
- e. Cut truss members by sawing or shearing: do not torch cut.
- f. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.
- g. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- h. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.

3.2 FASTENING

Fasten framing members together by welding or by using self-drilling, self-tapping screws. Electrodes and screw connections must be as required and indicated in the design calculations.

3.2.1 Welds

All welding must be performed in accordance with AWS D1.3/D1.3M, as modified by AISI S100. All welders, welding operations, and welding procedures must be qualified according to AWS D1.3/D1.3M. Submit certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M. All welds must be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 43 mils.

3.2.2 Screws

Screws must be of the self-drilling self-tapping type, size, and location as required. Screw penetration through joined materials must not be less than three exposed threads. Minimum spacings and edge distances for screws must be as specified in AISI S100. Screws covered by sheathing materials must have low profile heads.

3.2.3 Anchors

Anchors must be of the type, size, and location as required.

3.2.4 Powder-Actuated Fasteners

Powder-actuated fasteners must be of the type, size, and location as required. Only use powder or other explosive material with the express written and permission of the FAA and/or airport authority and/or other Authorities Having Jurisdiction (AHJs).

3.3 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are

indicated.

3.3.1 Tracks

Provide accurately aligned runners at top and bottom of studs. Install sealer gasket under bottom of track on concrete slab or foundation. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners must be at least 3 inches from the edge of concrete slabs.

3.3.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings must include headers and supporting components as shown on the drawings. Headers must be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI S100. Bracing must be not less than the following:

<u>LOAD</u>	<u>HEIGHT</u>	<u>BRACING</u>
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.3.3 Joists and Trusses

- a. Provide a stud directly under each joist or truss. The maximum spacing of studs as indicated must be maintained.
- b. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.
- c. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- d. Do not alter, cut, or remove framing members or connections of trusses.

3.3.4 Erection Tolerances

- a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, must be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
 - (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
 - (4) Face of framing members: 1/4 inch in 8 feet from a true plane.

- b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive must be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/8 inch in 8 feet from a straight line;
 - (3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
 - (4) Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes low-VOC and Low-Odor joint sealants for the following locations:

1.1.1.1 Interior Joints in Vertical Surfaces

Including:

- a. Perimeter joints between interior wall surfaces and frames of interior doors.
- b. Tile wall and floor joints.
- c. Perimeter joints between existing exterior metal siding, and louver and window unit systems.
- d. Other joints as indicated.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

1.2.1 Elastomeric Joint Sealants:

Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.2.2 Joint Sealants for Interior Sealants:

Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.2.3 No Off-Gassing:

Provide products that will not produce off-gassing of VOC's after product is installed and properly cured.

1.3 SUBMITTALS

SD-01 Preconstruction Submittals

Qualification data complying with requirements specified in "QUALITY ASSURANCE" article. Include list of completed projects with project names addresses, names of architects and owners, plus other information specified.

SD-03 Product Data from manufacturers for each joint sealant product required.

- 1. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with

local regulations controlling use of volatile organic compounds.

2. Provide Safety Data Sheets (SDS) for the following:

- a. Elastomeric joint sealants
- b. Primer.
- c. Cleaners for nonporous surfaces.

Elastomeric Joint Sealants

Plastic Foam Joint Fillers

Open Cell Polyurethane Foam

Closed Cell Polyethylene Foam

Bond Breaker Tape

Primer

Cleaners For Non-Porous Surfaces

Masking Tape

SD-04 Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

SD-06 Test Reports

Preconstruction field test reports, indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

SD-07 Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

SD-09 Manufacturer's Field Reports

Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

SD-10 Operation and Maintenance Data

Refer to Division 01 Sections.

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualification Data:

Engage an experienced installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

1.4.2 Single Source Responsibility for Joint Sealant Materials:

Obtain joint sealants and joint backer materials from a single manufacturer for each different product required.

1.4.3 Conduct Testing:

Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24 month period preceding date of the submittal of test results to the PM designee.

1.4.3.1 Compliance:

Test elastomeric sealants for compliance with requirements specified by reference to ASTM C920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C719), low temperature, flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.

1.4.3.2 Test Results:

Include test results performed on joint sealants after they have cured for 1 year.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery:

Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

1.5.2 Storage and Handling:

Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

1.6.1 Temperature Conditions:

When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg F.

1.6.1.1 Wet Conditions:

When joint substrates are wet.

1.6.2 Joint Width Conditions:

Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

1.6.3 Joint Substrate Conditions:

Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.7 SEQUENCING AND SCHEDULING

1.7.1 Installation Sequence:

Sequence installation of joint sealants to occur not less than 21 nor more than 30 calendar days after completion of waterproofing, unless otherwise indicated.

1.8 REFERENCES

ASTM International (ASTM)

ASTM C661	Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
ASTM C719	Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1193	Standard Guide for Use of Joint Sealants
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D1004	Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

2.1.1 Compatibility:

Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions

of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.1.2 Colors:

Provide selections made by PM Designee from manufacturer's full range of standard colors for typical applications.

2.1.3 VOC-Compliance:

Provide VOC-compliant sealants. Products must not produce off-gassing after proper curing is achieved.

2.2 ELASTOMERIC JOINT SEALANTS

2.2.1 Elastomeric Sealant Standard:

Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C920.

2.2.2 Neutral-Curing Silicone As Follows:

2.2.2.1 VOC Content:

0 g/L or 0 lbs. per gallon less water and exempt solvents.

2.2.2.2 Type:

Type S (ASTM C920).

2.2.2.3 Grade:

NS (ASTM C920).

2.2.2.4 Class:

25 (ASTM C920).

2.2.2.5 Use:

NT, A and M.

2.2.2.6 Shore A Hardness:

30 (ASTM D2240)

2.2.2.7 Joint Movement Capability (after 14 cure days):

Extension: 25 percent. Compression: 25 percent.

2.2.2.8 Tear Resistance:

18pli (ASTM D624).

2.2.2.9 Elongation at Break:

320 percent (ASTM D412).

2.2.2.10 Tensile Strength:

275psi (ASTM D412).

2.2.2.11 Uses Related to Joint Substrates:

Expansion and control joints in concrete and masonry; metal curtain walls, perimeter caulking of windows; conventional glazing. Adheres to metal, aluminum, galvanized steel, concrete and masonry. For exterior applications.

2.2.3 Multi-Purpose Mildew-Resistant Silicone Sealant:

2.2.3.1 VOC Content:

0 g/L or 0 lbs. per gallon less water and exempt solvents.

2.2.3.2 Type:

Type S (ASTM C920).

2.2.3.3 Grade:

NS (ASTM C920).

2.2.3.4 Class:

25 (ASTM C920).

2.2.3.5 Use:

NT, G and A.

2.2.3.6 Shore A Hardness:

25 (ASTM C661)

2.2.4 Low-Modulus, High-Movement, Fast-Curing Sealant:

2.2.4.1 VOC Content:

2.07 g/L or 0.02 lbs. per gallon. Complies with low-VOC regulations.

2.2.4.2 Type:

S (ASTM C920).

2.2.4.3 Grade:

NS (ASTM C920).

2.2.4.4 Class:

25 (ASTM C920).

2.2.4.5 Use:

NT, M, A, G and O.

2.2.4.6 Tensile Strength:

290 psi (ASTM D412).

2.2.4.7 Ultimate Elongation at Break:

865 percent (ASTM D412).

2.2.4.8 Hardness, Shore A:

20 (ASTM C661).

2.2.4.9 Tear Strength:

70 lb/in (ASTM D1004).

2.2.4.10 Use:

Glass, aluminum, concrete, masonry, wood, stone, curtain wall construction, expansion wall joints. Interior and exterior use. Do not use on horizontal traffic-bearing surfaces.

2.3 ELECTRICAL CONDUIT DUCT SEAL

Refer to Sections 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS and 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS for sealing requirements.

2.4 JOINT SEALANT BACKING

2.4.1 General:

Provide sealant backings of material and type that are non-staining; 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. Provide backing and filler material by sealant manufacturer to greatest extent possible, or products recommended by sealant manufacturer.

2.4.2 Plastic Foam Joint Fillers:

Preformed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

2.4.2.1 Open Cell Polyurethane Foam.

2.4.2.2 Closed Cell Polyethylene Foam:

Nonabsorbent to liquid water and gas, non-outgassing in unruptured state.

2.4.3 Bond Breaker Tape:

Polyethylene tape or other plastic tape as 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-adhesivetape where applicable.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Primer:

Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substratetests and field tests.

2.5.2 Cleaners for Non-Porous Surfaces:

Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

2.5.3 Masking Tape:

Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

3.2.1 Surface Cleaning of Joints:

Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

3.2.1.1 Foreign Material Removal:

Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

3.2.1.2 Porous Surface Cleaning:

Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar 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. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3.2.1.3 Non-Porous Surface Cleaning:

Clean metal, glass and other 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.

3.2.2 Joint Priming:

Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substratetests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.2.3 Masking Tape:

Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

3.3.1 General:

Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

3.3.2 Sealant Installation Standard:

Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

3.3.3 Installation of Sealant Backings:

Install sealant backings to comply with the following requirements:

3.3.3.1 Joint Filler Installation:

Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

- a. Do not leave gaps between ends of joint fillers.
- b. Do not stretch, twist, puncture, or tear joint fillers.
- c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

3.3.3.2 Bond Breaker Tape Installation:

Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

3.3.4 Installation of Sealants:

Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

3.3.5 Tooling of Non-Sag Sealants:

Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.3.5.1 Concave Joint Configuration:

Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.

3.3.5.2 Masking Tape:

Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

Protect joint sealants 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 joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

-- End of Section --

SECTION 08 91 00

LOUVERS AND VENTS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Fixed, Extruded-Aluminum Louvers:

Fixed, extruded-aluminum louvers meeting the requirements of Authorities Having Jurisdiction (AHJs).

1.2 REFERENCES

American Architectural Manufacturers' Association (AAMA)

AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

Air and Movement Control Association (AMCA)

AMCA 500-L Laboratory Methods of Testing Louvers for Rating

AMCA 501 Louver Application Manual and Design Guide

AMCA 540 Test Method for Louvers Impacted by Wind Borne Debris

AMCA 550 Listed Wind-Driven-Rain-Resistant Louver

ASTM International (ASTM)

ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.3 DEFINITIONS

1.3.1 Louver Terminology:

Definitions of terms for metal louvers contained in AMCA 501 apply to this Section, unless otherwise defined in this Section or in referenced standards.

1.3.2 Drainable-Blade Louver:

Louver designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Structural Performance:

Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1.4.1.1 Wind Load:

Uniform pressures (velocity pressures) indicated on structural drawings, acting inward or outward.

1.4.2 Air-Performance, Water-Penetration, and Air-Leakage Ratings:

Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 32 inches wide by 16 inches high. Test units according to AMCA 500-L, AMCA 540, and AMCA 550..

1.4.2.1 Testing:

Perform testing on unpainted, cleaned, degreased units.

1.4.2.2 Water-Penetration Testing:

Perform water-penetration testing on louvers without screens.

1.5 SUBMITTALS

SD-01 Preconstruction Submittals

Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

SD-02 Shop Drawings

For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

1. For installed louvers and vents indicated to comply with design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

SD-03 Product Data

For each type of product specified.

Aluminum Extrusions

Fasteners

Anchors And Inserts

Fixed, Extruded-Aluminum Louvers

Louver Screens

SD-04 Samples

Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

SD-06 Test Reports

Product Test Reports: Indicate compliance of products with requirements based on comprehensive testing of current products.

SD-07 Certificates

Product Certificates: Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500-L, AMCA 540, and AMCA 550 and complying with AMCA's Certified Ratings Program.

1.6 QUALITY ASSURANCE

1.6.1 Professional Engineer Qualification Data:

A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of louvers that are similar to those indicated for this Project in material, design, and extent.

1.6.2 Source Limitations:

Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements:

Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 DELIVERY, STORAGE AND HANDLING

1.8.1 Delivery:

Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

1.8.2 Storage:

Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

1.8.3 Handling:

Protect materials and finishes during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Extrusions:

ASTM B221, alloy 6063-T5 or T6.

2.1.2 Fasteners:

Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated or required by manufacturer. Do not use metals that are incompatible with joined materials.

2.1.3 Anchors and Inserts:

Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

2.2 FABRICATION, GENERAL

2.2.1 Assembly:

Assemble louvers in factory to minimize field splicing and assembly.

2.2.2 Spacing:

Maintain equal louver blade spacing to produce uniform appearance.

2.2.3 Frame Fabrication:

Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.

2.2.4 Supports, Anchorages, and Accessories:

Include supports, anchorages, and accessories required for complete assembly.

2.2.5 Sills:

Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

2.3.1 Louver Construction:

Provide fixed-blade louvers with extruded-aluminum frames and blades.

2.3.2 Horizontal, Drainable-Blade Louvers:

As follows:

2.3.2.1 Frame Depth:

6 inches, unless otherwise indicated.

2.3.2.2 Frame Thickness:

0.081 inch min.

2.3.2.3 Blade Thickness:

0.081 inch min

2.3.2.4 Blade Angle and Spacing:

+/- 37 degrees and +/- 5 inches o.c. for 6-inch-deep louvers.

2.3.2.5 Vertical Supports:

Hidden vertical supports at 24 inches maximum center to center spacing to allow continuous line appearance up to 120 inches (3,048 mm).

2.3.2.6 Sill:

Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.

2.3.2.7 Assembly:

All welded construction.

2.3.3 Louver Performance Data:

2.3.3.1 Compliance:

Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500-L.

2.3.3.2 Free Area:

35 percent, nominal.

2.3.3.3 Performance Requirements:

Maximum standard airflow not less than 800 cfm with not more than 0.10-inch wg static-pressure loss.

2.4 ALUMINUM FACTORY FINISH

2.4.1 High-Performance Organic Coating Finish:

AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.4.1.1 Fluoropolymer Two-Coat Coating System:

Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

- a. Color: As selected by Architect from manufacturer's full range of colors.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Coordination:

Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION

3.2.1 Locations:

Install units at locations indicated on the drawings and in accordance with manufacturer's instructions.

3.2.2 Placement:

Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

3.2.3 Joints:

Form closely fitted joints with exposed connections accurately located and secured.

3.2.4 Perimeter Reveals and Openings:

Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

3.2.5 Repair and Restoration:

Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2.6 Gaskets, Flashings, Joint Fillers, and Insulation:

Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required.

3.3 ADJUSTING, CLEANING, AND PROTECTING

3.3.1 Operational Test:

Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

3.3.2 Periodic Cleaning:

Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

3.3.3 Cleaning prior to Final Inspection:

Before final inspection, clean louver surfaces in accordance with manufacturer's instructions.

3.3.4 Protection:

Protect louvers and vents from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.

3.3.5 Restoration:

Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the PM Designee, remove damaged units and replace with new units.

3.3.5.1 Final Cleaning and Touch-Up:

Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

-- End of Section --

SECTION 09 29 00
GYP SUM BOARD

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Interior gypsum board.

1.2 SUBMITTALS

SD-03 Product Data:

For each type of product indicated.

Interior Gypsum Board

Sound Attenuating Gypsum Board

Interior Trim

Aluminum Trim

Joint Tape

Joint Compound For Interior Gypsum Wallboard

Laminating Adhesive

Steel Drill Screws

Sound Attenuation Blankets

Acoustical Sealant

Thermal Insulation

Vapor Retarder

SD-04 Samples

For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.3 QUALITY ASSURANCE

1.3.1 Fire-Resistance-Rated Assemblies:

For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

1.3.2 STC-Rated Assemblies:

For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.4 REFERENCES

ASTM International (ASTM)

ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C475	Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C665	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C840	Standard Specification for Application and Finishing of Gypsum Board
ASTM C919	Standard Practice for Use of Sealants in Acoustical Applications
ASTM C1002	Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1396/C1396M	Standard Specification for Gypsum Board
ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E413	Classification for Rating Sound Insulation

1.5 STORAGE AND HANDLING

Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic,

and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

1.6.1 Environmental Limitations:

Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

1.6.2 Conditions for Installation:

Do not install interior products until installation areas are enclosed and conditioned.

1.6.3 Confirmation That Panels Are Water-Damage-Free and Mold-Free:

Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1.6.3.1 Water Damage Indicators:

Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

1.6.3.2 Mold Indicators:

Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 PANELS, GENERAL

2.1.1 Size:

Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

2.2.1 General:

Complying with ASTM C1396/C1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

2.2.2 Regular Type:

2.2.2.1 Thickness:

Minimum 5/8 inch (12.7 mm), or as required by fire-resistance-rated assembly indicated on drawings.

2.2.2.2 Long Edges:

Tapered.

2.2.3 Type X:

2.2.3.1 Thickness:

5/8 inch (15.9 mm).

2.2.3.2 Long Edges:

Tapered.

2.2.4 Type C:

2.2.4.1 Thickness:

As required by fire-resistance-rated assembly indicated on Drawings.

2.2.4.2 Long Edges:

Tapered.

2.2.5 Ceiling Type:

Manufactured to have more sag resistance than regular-type gypsum board.

2.2.5.1 Thickness:

5/8 inch (12.7 mm).

2.2.5.2 Long Edges:

Tapered.

2.2.6 Abuse-Resistant Type:

Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.

2.2.6.1 Core:

As indicated on Drawings.

2.2.6.2 Long Edges:

Tapered.

2.2.7 Moisture- and Mold-Resistant Type:

With moisture- and mold-resistant core and surfaces.

2.2.7.1 Core:

5/8 inch (15.9 mm), Type X.

2.2.7.2 Long Edges:

Tapered.

2.3 TRIM ACCESSORIES

2.3.1 Interior Trim:

ASTM C1047.

2.3.1.1 Material:

Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

2.3.1.2 Shapes

Include:

- a. Cornerbead.
- b. Bullnose bead.
- c. LC-Bead: J-shaped; exposed long flange receives joint compound.
- d. L-Bead: L-shaped; exposed long flange receives joint compound.
- e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- f. Expansion (control) joint.
- g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.3.2 Aluminum Trim:

Extruded accessories of profiles and dimensions indicated.

2.3.2.1 Aluminum:

Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.

2.3.2.2 Finish:

Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.4 JOINT TREATMENT MATERIALS

2.4.1 General:

Comply with ASTM C475/C475M.

2.4.2 Joint Tape:

2.4.2.1 Interior Gypsum Wallboard:

Paper, or as recommended by manufacturer.

2.4.3 Joint Compound for Interior Gypsum Wallboard:

For each coat use formulation that is compatible with other compounds

applied on previous or for successive coats.

2.4.3.1 Prefilling:

At open joints and damaged surface areas, use setting-type taping compound.

2.4.3.2 Embedding and First Coat:

For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

- a. Use setting-type compound for installing paper-faced metal trim accessories.

2.4.3.3 Fill Coat:

For second coat, use setting-type, sandable topping compound.

2.4.3.4 Finish Coat:

For third coat, use setting-type, sandable topping.

2.4.3.5 Skim Coat:

For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

2.5.1 General:

Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

2.5.2 Laminating Adhesive:

Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

2.5.3 Steel Drill Screws:

ASTM C1002, unless otherwise indicated.

2.5.3.1 Compliance:

Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2.5.3.2 Fastening:

For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

2.5.4 Sound Attenuation Blankets:

ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

2.5.4.1 Fire-Resistance-Rated Assemblies:

Comply with mineral-fiber requirements of assembly.

2.5.5 Acoustical Sealant:

As specified in Section 07 92 00 "JOINT SEALANTS."

2.5.6 Thermal Insulation:

As specified in Section 07 21 00 "THERMAL INSULATION."

2.5.7 Vapor Retarder:

As specified in Section 07 21 00 "THERMAL INSULATION."

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Area and Substrate Examination:

Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

3.1.2 Panel Examination:

Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

3.1.3 Conditions for Proceeding:

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

3.2.1 Compliance:

Comply with ASTM C840.

3.2.2 Ceiling Panels:

Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

3.2.3 Butting Panels:

Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

3.2.4 Location:

Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided

behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

3.2.5 Control and Expansion Joints:

Form control and expansion joints with space between edges of adjoining gypsum panels.

3.2.6 Covering:

Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

3.2.6.1 Coverage:

Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

3.2.6.2 Gypsum Panel Fitting:

Fit gypsum panels around ducts, pipes, and conduits.

3.2.6.3 Gypsum Panel Cutting:

Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

3.2.7 Perimeter Isolation:

Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4-to 1/2-inch- (6.4- to 12.7-mm-)wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.2.8 STC-Rated Assemblies:

Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

3.3.1 Interior Gypsum Board Installation:

Install interior gypsum board in the following locations:

3.3.1.1 Regular Type:

Vertical surfaces, unless otherwise indicated.

3.3.1.2 Type X:

As indicated on Drawings and Where required for fire-resistance-rated assembly.

3.3.1.3 Type C:

Where required for specific fire-resistance-rated assembly indicated.

3.3.1.4 Ceiling Type:

Ceiling surfaces.

3.3.1.5 Abuse-Resistant Type:

As indicated on Drawings

3.3.1.6 Moisture- and Mold-Resistant Type:

As indicated on Drawings

3.3.2 Single-Layer Application:

3.3.2.1 Gypsum Panel Application on Ceilings:

On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.

3.3.2.2 Fastening Methods:

Apply gypsum panels to supports with steel drill screws.

3.3.3 Multilayer Application:

3.3.3.1 Base Layer Gypsum Board Application on Ceilings:

On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

3.3.3.2 Fastening Methods:

Fasten base layers and face layers separately to supports with screws, or as indicated or required by fire-resistant-rated assembly.

3.3.4 Laminating to Substrate:

Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has

set.

3.4 INSTALLING TRIM ACCESSORIES

3.4.1 General:

For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.4.2 Control Joints:

Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

3.4.3 Interior Trim:

Install in the following locations:

3.4.3.1 Cornerbead:

Use at outside corners, unless otherwise indicated.

3.4.3.2 Bullnose Bead:

Use where indicated

3.4.3.3 LC-Bead:

Use where indicated

3.4.3.4 L-Bead:

Use where indicated

3.4.3.5 U-Bead:

Use at exposed panel edges unless otherwise indicated

3.4.3.6 Curved-Edge Cornerbead:

Use at curved openings.

3.4.4 Aluminum Trim:

Install in locations indicated on Drawings

3.5 FINISHING GYPSUM BOARD

3.5.1 General:

Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

3.5.2 Prefilling:

Prefill open joints, rounded or beveled edges, and damaged surface areas.

3.5.3 Joint Tape Application:

Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

3.5.4 Gypsum Board Finish Levels:

Finish panels to levels indicated below and according to ASTM C840:

3.5.4.1 Level 1:

Ceiling plenum areas, concealed areas, and where indicated.

3.5.4.2 Level 2:

Panels that are substrate for tile and acoustical tile.

3.5.4.3 Level 3:

Panels that are to receive a heavy-grade wallcovering as a final finish.

3.5.4.4 Level 4:

At panel surfaces that will be exposed to view, unless otherwise indicated

a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5.4.5 Level 5:

Panels that are to receive gloss, semi-gloss or enamel paints.

a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.6 PROTECTION

3.6.1 Protection of Installed Products:

Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

3.6.2 Panel Removal and Replacement:

Remove and replace panels that are wet, moisture damaged, and mold damaged.

3.6.2.1 Water or Moisture Damage:

Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

3.6.2.2 Mold Damage:

Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

-- End of Section --

**SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes acoustical panels and exposed suspension systems for ceilings.

1.1.2 Furnished Products:

Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.2 REFERENCES

Architectural Aluminum Manufacturers Association (AAMA)

AAMA 611-24	Specification for Anodized Architectural Aluminum
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ASTM International (ASTM)

ASTM A580	Standard Specification for Stainless Steel Wire
ASTM A641	Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C635	Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM D3273	Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM D3724	Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E795	Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1264	Standard Classification for Acoustical Ceiling Products
ASTM F593	Standard Specification for Stainless Steel

ASTM F594

Bolts, Hex Cap Screws, and Studs
Standard Specification for Stainless Steel
Nuts

ASTM G21

Standard Practice for Determining
Resistance of Synthetic Polymeric
Materials to Fungi

1.3 DEFINITIONS

1.3.1 AC:

Articulation Class.

1.3.2 CAC:

Ceiling Attenuation Class.

1.3.3 LR:

Light Reflectance coefficient.

1.3.4 NRC:

Noise Reduction Coefficient.

1.3.5 NRTL:

Nationally Recognized Testing Laboratory.

1.3.6 NVLAP:

National Voluntary Laboratory Accreditation Program.

1.3.7 UNS:

Unified Numbering System for Metals and Alloys.

1.4 SUBMITTALS

SD-01 Preconstruction Submittals

Qualification Data: For testing agency.

SD-02 Shop Drawings

Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

Ceiling suspension system members.

Method of attaching hangers to building structure.

Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

Minimum Drawing Scale: 1/8 inch = 1 foot (1:96)

SD-03 Product Data

For each type of product indicated.

Acoustical Panels

Metal Suspension Systems

Metal Edge Moldings And Trim

Acoustical Sealant

SD-04 Samples

Samples for Initial Selection: For components with factory-applied color finishes.

SD-06 Test Reports

Field quality-control test reports.

Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

Research/Evaluation Reports: For each acoustical panel ceiling and components.

SD-10 Operation and Maintenance Data

Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

1.5.1 Acoustical Testing Agency Qualifications:

An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

1.5.2 Source Limitations:

1.5.2.1 Acoustical Ceiling Panel:

Obtain each type through one source from a single manufacturer.

1.5.2.2 Suspension System:

Obtain each type through one source from a single manufacturer.

1.5.3 Fire-Test-Response Characteristics:

Provide acoustical panel ceilings that comply with the following requirements:

1.5.3.1 Fire-Resistance Characteristics:

Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E119 by an NRTL acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

b. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.5.3.2 Surface-Burning Characteristics:

Provide acoustical panels with the following surface-burning characteristics complying with ASTM E1264 for Class A materials as determined by testing identical products per ASTM E84.

1.5.4 Preinstallation Conference:

Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage:

Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

1.6.2 Temperature and Moisture Control:

Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.6.3 Handling:

Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

1.7.1 Environmental Limitations:

Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7.1.1 Pressurized Plenums:

Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

1.9.1 Furnishing:

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.9.1.1 Acoustical Ceiling Panels:

Full-size panels equal to 2.0 percent of quantity installed but not less than four (4) unopened boxes for each type and finish.

1.9.1.2 Hold-Down Clips:

Equal to 2.0 percent of quantity installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

2.1.1 Acoustical Panel Standard:

Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

2.1.1.1 Mounting Method for Measuring NRC:

Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E795.

2.1.2 Acoustical Panel Colors and Patterns:

Match appearance characteristics indicated for each product type.

2.1.2.1 Pattern Designations:

Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E1264 and not manufacturers' proprietary product designations, provide products selected by COR from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.1.3 Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment:

Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

2.2.1 Modular Size:

As indicated on drawings (match existing).

2.2.2 Antimicrobial Treatment:

Broad spectrum fungicide and bactericide based.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

2.3.1 Metal Suspension System Standard:

Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C635.

2.3.2 Finishes and Colors, General:

Match existing finish and color if replacement required..

2.3.3 Wire Hangers, Braces, and Ties:

Use existing if possible. If required, provide wires complying with the following requirements:

2.3.3.1 Zinc-Coated, Carbon-Steel Wire:

ASTM A641, Class 1 zinc coating, soft temper.

2.3.3.2 Stainless-Steel Wire:

ASTM A580, Type 304, nonmagnetic.

2.3.3.3 Nickel-Copper-Alloy Wire:

ASTM B164, nickel-copper-alloy UNS No. N04400.

2.3.3.4 Size:

Select wire diameter so its stress at 3 times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

2.3.4 Hanger Rods:

Mild steel, zinc coated or protected with rust-inhibitive paint.

2.3.5 Hold-Down Clips:

Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.3.6 Impact Clips:

Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 METAL EDGE MOLDINGS AND TRIM

2.4.1 Roll-Formed, Sheet-Metal Edge Moldings and Trim:

Use existing if possible. If required, type and profile to match existing or, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.4.1.1 Standard Edge Moldings:

Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

2.4.1.2 Lay-In Panels:

For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2.4.1.3 Circular Ceiling Penetrations:

For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.4.2 Extruded-Aluminum Edge Moldings and Trim:

Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

2.4.2.1 Aluminum Alloy:

Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B221 (ASTM B221M) for Alloy and Temper 6063-T5.

2.5 ACOUSTICAL SEALANT

2.5.1 Compliance:

Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2.5.1.1 Acoustical Sealant for Exposed and Concealed Joints

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Substrates, Areas, and Conditions:

Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present,

for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

3.1.1.1 Conditions for Proceeding:

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

3.3.1 General:

Install hanger system if required due to damage to system, Otherwise only acoustical panels are being replaced.

Install acoustical panel ceilings to comply with ASTM C636 and seismic design requirements indicated, per manufacturer's written instructions and Ceiling and Interior Systems Construction Association's (CISCA's) "Ceiling Systems Handbook."

3.3.2 Ceiling Hanger Suspension:

Suspend ceiling hangers from building's structural members and as follows:

3.3.2.1 Hanger Positioning:

Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

3.3.2.2 Avoiding Obstructions:

Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3.3.2.3 Trapezes:

Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

3.3.2.4 Wire Hanger Securement:

Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail

due to age, corrosion, or elevated temperatures.

3.3.2.5 Hanger Fastening:

Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

3.3.2.6 Carrying Channels:

When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

3.3.2.7 Steel Deck Tabs:

Do not attach hangers to steel deck tabs.

3.3.2.8 Steel Roof Deck:

Do not attach hangers to steel roof deck. Attach hangers to structural members.

3.3.2.9 Hanger Spacing:

Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

3.3.2.10 Supplemental Suspension Member and Hanger Sizing:

Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

3.3.3 Edge Moldings and Trim Installation:

Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

3.3.3.1 Acoustical Sealant Application:

Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.3.3.2 Molding Attachment:

Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

3.3.3.3 No Exposed Fasteners:

Do not use exposed fasteners, including pop rivets, on moldings and trim.

3.3.4 Suspension System Runner Installation:

Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

3.3.5 Acoustical Panel Installation:

Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

3.3.5.1 Directionally Patterned Panels:

Arrange directionally patterned acoustical panels as follows:

- a. Install panels with pattern running in one direction parallel to short axis of space.

3.3.5.2 Square-Edged Panels:

For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3.3.5.3 Hold-Down Clips:

Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

-- End of Section --

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Resilient Base.

1.1.1.2 Resilient Molding Accessories.

1.2 SUBMITTALS

SD-03 Product Data:

For each type of product indicated.

Resilient Base

Resilient Molding Accessories

Carpet Edge For Glue-Down Applications

Nosing For Resilient Floor Covering

Reducer Strip For Resilient Floor Covering

Transition Strips

Trowelable Leveling And Patching Compounds

Adhesives

Metal Edge Strips

Floor Polish

SD-04 Samples

Samples for Initial Selection: For each type of product indicated.

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.3 DELIVERY, STORAGE, AND HANDLING

Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.4 PROJECT CONDITIONS

1.4.1 Maintenance of Ambient Temperatures:

Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1.4.1.1 48 hours before installation.

1.4.1.2 During installation.

1.4.1.3 48 hours after installation.

1.4.2 Prior to Substantial Completion:

Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

1.4.3 After Other Finishing Operations:

Install resilient products after other finishing operations, including painting, have been completed.

1.5 EXTRA MATERIALS

1.5.1 Furnishing:

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5.1.1 Furnishing Minimum:

Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient but not less than four (4) unopened boxes for each type and finish product installed.

1.6 REFERENCES

ASTM International (ASTM)

ASTM F710	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1861	Standard Specification for Resilient Wall Base
ASTM F2169	Standard Specification for Resilient Stair Treads

PART 2 PRODUCTS

2.1 RESILIENT BASE

2.1.1 Resilient Base Standard:

ASTM F1861.

2.1.1.1 Material Requirement:

Type TV (vinyl, thermoplastic) Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).

2.1.1.2 Manufacturing Method:

Group I (solid, homogeneous) or Group II (layered).

2.1.1.3 Style:

Cove (base with toe)

2.1.2 Minimum Thickness:

0.125 inch (3.2 mm)

2.1.3 Height:

4 inches (102 mm)

2.1.4 Lengths:

Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

2.1.5 Outside Corners:

Preformed

2.1.6 Inside Corners:

Preformed

2.1.7 Finish:

If not otherwise indicated to be as selected by Architect from manufacturer's full range.

2.1.8 Colors and Patterns:

If not otherwise indicated to be as selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORIES

2.2.1 Description:

Carpet edge for glue-down applications, Nosing for carpet, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet, or Transition strips.

2.2.2 Material:

Vinyl

2.2.3 Profile and Dimensions:

As indicated

2.2.4 Colors and Patterns:

If not otherwise indicated, to be selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

2.3.1 Trowelable Leveling and Patching Compounds:

Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

2.3.2 Adhesives:

Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

2.3.3 Metal Edge Strips:

Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Compliance:

Examine substrates, with installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

3.1.2 Verification:

Verify that finishes of substrates comply with tolerances and other requirements specified in other sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

3.1.3 Correction:

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

3.2.1 Substrate Preparation:

Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

3.2.2 Concrete Substrates for Resilient Stair Treads and Accessories:

Prepare according to ASTM F710.

3.2.2.1 Verification:

Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

3.2.2.2 Substrate Coating Removal:

Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

3.2.2.3 Alkalinity and Adhesion Testing:

Perform tests recommended by manufacturer.

3.2.2.4 Moisture Testing:

Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing. Follow manufacturer's requirements for moisture testing.

3.2.3 Filling Spaces in Substrates:

Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

3.2.4 Temperature:

Do not install resilient products until they are same temperature as the space where they are to be installed.

3.2.4.1 Location Prior to Installation:

Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.2.5 Cleaning Substrates:

Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

3.3.1 Compliance:

Comply with manufacturer's written instructions for installing resilient base.

3.3.2 Application:

Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

3.3.3 Lengths:

Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

3.3.4 Adherence:

Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

3.3.5 Stretching:

Do not stretch resilient base during installation.

3.3.6 Filling Voids:

On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

3.3.7 Preformed Corners:

Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

3.4.1 Compliance with Manufacturer's Instructions:

Comply with manufacturer's written instructions for cleaning and protection of resilient products.

3.4.2 Operations:

Perform the following operations immediately after completing resilient product installation:

3.4.2.1 Removal of Adhesive and Blemishes:

Remove adhesive and other blemishes from exposed surfaces.

3.4.3 Protection:

Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

-- End of Section --

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes modular, carpet tile.

1.2 SUBMITTALS

SD-01 Preconstruction Submittals

Qualification Data: For Installer.

Product Schedule: For carpet tile. Use same designations indicated on Drawings.

SD-02 Shop Drawings

Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

SD-03 Product Data

For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

Carpet Tile

Interface Modular Carpet Tiles

Primary Backing/Backcoating

Secondary Backing:

Applied Soil-Resistance Treatment:

Antimicrobial Treatment:

Trowelable Leveling And Patching Compounds

Adhesives

SD-04 Samples

For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.

2. Exposed Edge, Transition, and other Accessory Stripping:
12-inch- (300-mm-) long Samples.

SD-06 Test Reports

Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

SD-08 Manufacturer's Instructions

Carpet Tile Manufacturer's Written Installation Instructions

SD-10 Operation and Maintenance Data

For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

SD-11 Closeout Submittals

Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualification Data:

An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.3.2 Preinstallation Conference:

Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Compliance:

Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

1.5.1 Compliance:

Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

1.5.2 Environmental Limitations:

Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.5.3 Physical Limitations:

Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.5.4 Demountable Partitions:

Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

1.6.1 Special Warranty for Carpet Tiles:

Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1.6.1.1 Limitations:

Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

1.6.1.2 Failures:

Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.

1.6.1.3 Warranty Period:

10 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

1.7.1 Spares:

Furnish extra materials described below, before installation begins, that

match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7.1.1 Carpet Tile:

Full-size units equal to 5 percent of amount installed for each type indicated, but not less than (8.3 sq. m)three (3) unopened boxes of each type, color and pattern of tile.

1.8 REFERENCE STANDARDS

American Association of Textile Chemists and Colorists (AATCC)

AATCC TM16.1	Colorfastness to Light: Outdoor
AATCC TM16.2	Colorfastness to Light: Carbon-Arc
AATCC TM16.3	Colorfastness to Light: Xenon-Arc
AATCC TM24	Insects, Resistance of Textiles to
AATCC TM134	Electrostatic Propensity of Carpets
AATCC TM165	Colorfastness to Crocking: Textile Floor Coverings-Crockmeter
AATCC TM174	Antimicrobial Activity Assessment of New Carpets

ASTM International (ASTM)

ASTM C423	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D1335	Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
ASTM D2646	Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings
ASTM D3936	Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering
ASTM F710	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

Carpet and Rug Institute (CRI)

CRI 104	Standard for Installation Specification of Commercial Carpet
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International Organization for Standardization (ISO)

ISO 2551	Textile Floor Coverings and Textile Floor Coverings in Tile Form
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PART 2 PRODUCTS

2.1 CARPET TILE

2.1.1 Interface Modular Carpet Tiles

2.1.1.1 Color/Pattern:

As indicated on the Drawings.

2.1.2 Primary Backing/Backcoating:

Manufacturer's standard composite materials.

2.1.3 Secondary Backing:

Manufacturer's standard material.

2.1.4 Size:

50 cm x 50 cm

2.1.5 Applied Soil-Resistance Treatment:

Manufacturer's standard material

2.1.6 Antimicrobial Treatment:

Manufacturer's standard material.

2.1.7 Performance Characteristics:

As follows:

2.1.7.1 Dry Breaking Strength:

Not less than 100 lbf (445 N) per ASTM D2646.

2.1.7.2 Tuft Bind:

Not less than 15 pounds for loop pile and 6 pounds for cut pile per ASTM D1335.

2.1.7.3 Delamination:

ASTM D3936.

2.1.7.4 Dimensional Tolerance:

Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.

2.1.7.5 Dimensional Stability:

0.2 percent or less per ISO 2551 (Aachen Test).

2.1.7.6 Resistance to Insects:

Comply with AATCC 24.

2.1.7.7 Noise Reduction Coefficient (NRC):

per ASTM C423.

2.1.7.8 Colorfastness to Crocking:

Not less than 4, wet and dry, per AATCC 165.

2.1.7.9 Colorfastness to Light:

AATCC TM16.1, AATCC TM16.2, and AATCC TM16.3.

2.1.7.10 Antimicrobial Activity:

Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC TM174.

2.1.7.11 Electrostatic Propensity:

AATCC TM134.

2.2 INSTALLATION ACCESSORIES

2.2.1 Trowelable Leveling and Patching Compounds:

Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

2.2.2 Adhesives:

Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Substrate, Area, and Condition Examination:

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

3.1.2 Concrete Subfloors:

Verify that concrete slabs comply with ASTM F710 and the following:

3.1.2.1 Dry Slab Substrates:

Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

3.1.2.2 Subfloor Finishes:

Subfloor finishes comply with requirements specified on the contract drawings for slabs receiving carpet tile.

3.1.2.3 Damage-Free Subfloors:

Subfloors are free of cracks, ridges, depressions, scale, and foreign

deposits.

3.2 PREPARATION

3.2.1 General:

Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

3.2.2 Trowelable Leveling and Patching Compounds:

Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

3.2.3 Incompatible Substance Removal:

Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

3.2.4 Cleaning:

Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

3.3.1 General:

Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

3.3.2 Installation Method:

As recommended in writing by carpet tile manufacturer.

3.3.3 Dye Lots:

Maintain dye lot integrity. Do not mix dye lots in same area.

3.3.4 Cutting and Fitting:

Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

3.3.5 Extending:

Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

3.3.6 Maintenance:

Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.3.7 Pattern:

Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

3.4.1 Performance:

Perform the following operations immediately after installing carpet tile:

3.4.1.1 Removal of Adhesive, Sealer, and Blemishes:

Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

3.4.1.2 Removal of Protruding Yarns:

Remove yarns that protrude from carpet tile surface.

3.4.1.3 Vacuuming:

Vacuum carpet tile using commercial machine with face-beater element.

3.4.2 Compliance:

Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

3.4.3 Protection:

Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

-- End of Section --

**SECTION 09 91 00
PAINTING**

PART 1 GENERAL

1.1 WORK INCLUDES

1.1.1 Exterior Painting:

Includes all surfaces of the building and appurtenances as indicated.
Included are existing coated surfaces made bare by cleaning operations.

1.1.2 Interior Painting:

Includes all surfaces of the building and appurtenances. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

1.1.3 Mechanical and Electrical Painting:

Includes field coating of interior and exterior surfaces.

1.1.4 Non-specific Surfaces:

Where a space or surface is not specifically indicated to be painted, include the following items unless directed otherwise:

1.1.4.1 Exposed piping, conduit, and ductwork

1.1.4.2 Supports, hangers, air grilles, and registers

1.1.4.3 Miscellaneous metalwork and insulation coverings.

1.1.4.4 Cable trays.

1.1.4.5 New zinc-coated strut systems including all-thread rods.

1.1.5 Painting Included:

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

1.1.5.1 Surfaces behind Removable Objects:

Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

1.1.5.2 Factory Finished Surfaces:

New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

1.1.5.3 Damaged, Existing Coated Surfaces

Existing coated surfaces that are damaged during performance of the work.

1.1.6 Painting Excluded:

Do not paint the following unless indicated otherwise.

1.1.6.1 Concealed, Inaccessible Surfaces:

Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

1.1.6.2 Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

1.1.6.3 New zinc-coated, aluminum, and copper surfaces under insulation

1.1.6.4 New aluminum jacket on piping

1.1.6.5 New interior ferrous piping under insulation.

1.2 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Color Charts: Manufacturer's color chips and charts for use in preparation of color schedule.

SDS: Submit Manufacturer's Safety Data Sheets (SDS) for coatings, solvents, and other potentially hazardous materials.

Galvanized Metal Primer

Metal Primer

Exterior Ferrous Metal Paint

Enamel Undercoat

Interior Enamel

Exterior Flat Wall Paint

Enamel (Epoxy Resin) Semi-Gloss

Interior Latex Flat Paint

SD-08 Manufacturer's Instructions

Paint application instructions

1.3 DELIVERY AND STORAGE

Deliver materials in sealed, labeled containers bearing the manufacturer's name, brand designation, specification number, batch number, color, and date of manufacture. Restrict storage and mixing of materials to locations designated by the PM Designee. Products must be stored in an approved ventilated dry area, protected from contact with soil and from exposure to the elements. Keep products dry at all times.

1.4 HANDLING

Handle packaging and containers in a manner that will prevent damage to contents.

1.5 IDENTIFICATION OF MATERIALS

Containers must have labels with the following information:

1.5.1 Manufacturer's name

1.5.2 Type of paint

1.5.3 Color

1.5.4 Manufacturer's stock number

1.5.5 Instructions for reducing, where applicable

1.6 QUALITY ASSURANCE

1.6.1 Sample Area

A test area of wall surface from 5 to 10 square feet in size must be cleaned with the specified material, in accordance with the manufacturers instructions, for the approval of the PM Designee.

1.6.2 Inspection and Acceptance

In addition to meeting the previously specified requirements, demonstrate the mobility of moving components, including but not limited to swinging doors and cabinets, for inspection by the PM Designee. Perform this demonstration after appropriate curing and drying times of the coatings have elapsed and prior to invoicing for final payment.

1.7 REFERENCES

ASTM International (ASTM)

ASTM D1653 Standard Test Methods for Water Vapor
Transmission of Organic Coating Films

Society for Protective Coatings (SSPC)

SSPC-SP-3 Power Tool Cleaning

SSPC-SP-6 Commercial Blast Cleaning

PART 2 PRODUCTS

2.1 GENERAL

To the maximum extent practicable, use the materials of one manufacturer throughout the project. Primer must be of suitable type for each surface and compatible in each case with the finish paint. Coatings used must pass the test methods for water vapor transmission defined in ASTM D1653.

2.2 PAINT TYPES

2.2.1 Galvanized Metal Primer

2.2.1.1 Description:

A galvanized metal primer is a specialized primer designed for use on galvanized metal surfaces. It provides excellent adhesion to properly prepared galvanized metal and other non-ferrous metals like aluminum and brass. Key features include:

Quick Drying: Primers can become touch dry in 30 minutes and recoatable in 2 hours, allowing for efficient application.

Anti-Corrosion: Many primers contain anti-corrosion additives to protect the metal from rust and corrosion, extending the lifespan of the project.

Versatile Use: Suitable for both indoor and outdoor applications, making it ideal for various metal surfaces such as steps, handrails, and corrugated sheets.

Application: Primers should be applied to clean, dry surfaces to ensure the best results.

2.2.2 Metal Primer

2.2.2.1 Description:

A metal primer is a product that is painted or sprayed onto metal to prevent corrosion and rusting. Primers are made of acids and chemicals that penetrate within the rusty metal. Metal primers might contain additional materials to protect against corrosion, such as sacrificial zinc. Primers are used on metal hydroxides / oxides to improve the surface condition and to encourage bonding. Without a primer, paints applied to metals are prone to peeling.

2.2.3 Exterior Ferrous Metal Paint

2.2.3.1 Description:

Exterior ferrous metal paint is designed to protect and enhance the appearance of metal surfaces exposed to the elements. It offers protection against corrosion, improved aesthetics, and increased lifespan. The paint is available in various types, including water-based, oil-based, and direct-to-metal (DTM) paints, each with its own benefits and application methods. Proper surface preparation is crucial for achieving a long-lasting finish.

2.2.4 Enamel Undercoat

2.2.4.1 Description:

Enamel undercoats are primers that provide a smooth, even surface for enamel paints. They are essential for achieving a high-quality finish, especially when working with glossy or high-sheen topcoats. These undercoats help seal the surface, block stains, and improve the overall durability of the paint job.

Subtypes include:

Acrylic-Alkyd.

Latex.

Alkyd.

Interior Acrylic.

2.2.5 Interior Enamel

2.2.5.1 Description:

Enamel is a type of paint that is oil-based and has a glossy, hard, or long-lasting finish. It is water-resistant and washable. Enamel paint is composed of a base coat and a colorant.

2.2.6 Exterior Flat Wall Paint

2.2.6.1 Description:

Flat exterior wall paint is characterized by its non-reflective finish, which absorbs light rather than reflecting it. This results in a smooth, even appearance that is ideal for concealing imperfections on surfaces like siding or masonry. Flat paint is particularly effective at hiding surface flaws. However, it is less durable than higher-sheen finishes and may require more frequent touch-ups.

2.2.7 Enamel (Epoxy Resin) Semi-Gloss

2.2.7.1 Description:

Enamel epoxy resin semi-gloss is a high-performance, durable coating that offers excellent adhesion and resistance to chemicals and corrosion. It is suitable for various applications, including industrial environments, hospitals, and commercial spaces. This type of enamel is known for its hardwearing finish, excellent stain resistance, and anti-microbial properties, making it ideal for high-traffic areas. It can be applied using methods such as brush, roller, and airless spray, and is available in different colors and finishes to suit various design preferences.

2.2.8 Interior Latex Flat Paint

2.2.8.1 Description:

Interior latex flat paint is designed for use on various surfaces, including drywall, plaster, masonry, and primed wood. It offers a flat finish that provides maximum hiding and minimizes light refraction of irregular surfaces. This paint is ideal for commercial work where formal industry quality approvals are required and is not recommended for surfaces that require washing. It is also suitable for use on primed or previously painted drywall, masonry, plaster, wood, metal, and wallpapered surfaces.

2.3 COLOR SELECTION

Colors of finish coats must be as indicated or specified. Where not indicated or specified, colors must be selected by the PM Designee in

coordination with FAA. Provide color charts to assist with selection. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

Paint must not be applied to unprotected surfaces in wet weather nor to surfaces on which ice, frost, water, or dampness is visible. Paint must not be applied in rain, wind, snow, fog or mist nor when the steel surface temperature is below the dew point, resulting in condensation or moisture. When paint is applied in hot weather or thinned in cold weather, ensure that the specified thickness of paint coating is obtained. Do not apply exterior paint in damp, rainy weather nor until the surface has dried thoroughly from the effects of such weather. The temperature of the surface to be painted and of the surrounding air temperature must be maintained between 45 deg and 95 deg F during the application and drying period. Surfaces must be dry before paint is applied. Surface to be painted must be clean, dry, smooth and adequately protected from dampness.

3.1.1 Exterior Paint

Exterior paint must not be applied when the temperature is lower than 40 deg F or expected to fall below this temperature. Interior paint must not be applied when the temperature is lower than 60 deg F or expected to fall below this temperature.

3.1.2 Interior Paint

Interior paint must not be applied when, in the PM Designee's opinion, satisfactory results cannot be obtained due to high humidity and excessive temperature; however, failure of the PM Designee to notify the Subcontractor of the conditions will not relieve the Subcontractor of responsibility to produce satisfactory results.

3.1.3 Metallic Surfaces

Do not paint steel which is at a temperature which can cause blistering, porosity, or otherwise be detrimental to the life of the paint.

3.2 PREPARATION

3.2.1 Mounted Hardware

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixture, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workers skilled in the trades involved must reinstall removed items. Restore surfaces contaminated by coating materials to original condition and repair damaged items.

3.2.2 Surface

Surfaces must be inspected in regard to their suitability to receive a

finish. In the event that imperfections due to materials or workmanship appear on surfaces, appropriate corrections must be made at no additional cost to the Contractor or to the Government. Remove dirt, splinters, loose particles, grease, oil, and other substances deleterious to coating performance as specified for each substrate.

3.2.3 Protection

Products and materials placed prior to painting must be removed or protected. Remove protection upon completion of painting.

3.2.4 Cleaning of Surfaces

Surfaces to be painted must be cleaned as required to remove dust and dirt.

3.2.4.1 Cleaning Ferrous Surfaces

Ferrous surfaces, interior and exterior, that have not been shop-coated must be solvent-cleaned to remove oil and grease, then mechanically cleaned by power wire-brushing or blast cleaning to remove loose rust, loose mill-scale and other foreign substances. Blast cleaning must conform to the Society for Protective Coatings (fka Steel Structures Painting Council) Specification SSPC-SP-6 for commercial sandblasting. Power tool cleaning must conform to SSPC Specification SSPC-SP-3. Cleaning must be scheduled to permit priming of the cleaned areas on the same day. In the event the cleaned surfaces are left unprimed until the formation of corrosion, the affected areas must be cleaned again. Minor amounts of residual rust that cannot be removed except by white metal blast-cleaning, and tight mill-scale that cannot be removed by applying a sharp knife to any edge, will be permitted. After cleaning, one coat of paint must be applied to a minimum dry film thickness of 1 mil. Shop-coated metal must be protected from corrosion before and after installation by treating corroded areas immediately upon detection. Rust spots, and spots where shop coat has been abraded, must be sanded to bright metal and recoated with a primer.

3.2.4.2 Fabricated and Assembled Items

Fabricated and assembled items which are normally cleaned and primed in accordance with the manufacturer's standard practice may be exempted from the requirements for surface preparation and first coat specified on the drawings upon specific request by the Subcontractor and approval by the Subcontract Administrator (SA). Similarly, items which are normally painted with a complete coating system in accordance with the manufacturer's standard practice may be exempted entirely from the surface preparation and painting requirements herein, provided the finish coat is of acceptable color and quality and is touched up as necessary in the field. Requests for exemption must be accompanied by a description of the manufacturer's standard coating including surface preparation, type of paint, dry film thickness and whether baked or air-dried.

3.2.4.3 Nonferrous Metal Surfaces

All nonferrous metal surfaces, such as aluminum alloy (except anodized), copper, zinc-copper-alloy, and zinc-coated surfaces, including nonferrous surfaces not to be painted, must be solvent-cleaned as necessary to remove all oil, grease or other foreign substances. After cleaning, all nonferrous surfaces to be painted must be treated with vinyl type wash coat as hereinafter specified. Painting to protect aluminum from contact

with dissimilar materials should be specified under the section of the specification covering the specific item. All zinc-coated metal must be protected from corrosion before and after installation by treating cut, scarred, corroded, or abraded spots immediately upon detection. Such spots must be thoroughly wire-brushed, cleaned and smoothed, treated with vinyl wash coat or primed with zinc dust or zinc dust-zinc oxide metal primer, and then painted when necessary with a finish color coating which will match the color of adjoining surface.

3.2.4.4 Gypsum Board

Gypsum board must be dry. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with spackling compound and sand smooth.

3.2.5 Preparation of Wood and Plywood Surface

3.2.5.1 Surface Cleaning

Surfaces must be free from dust and other deleterious substances and in a condition approved by the PM Designee prior to receiving paint or other finish. Do not use water to clean uncoated wood.

3.2.5.2 Removal of Fungus and Mold

Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5% sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

3.2.5.3 Prime Coat for Exterior Surfaces

Prime coat before wood becomes dirty, warped, or weathered.

3.2.5.4 Cracks and Nailheads

Set and putty stop nailheads and putty cracks after the prime coat has dried.

3.2.6 Touch-Ups

Scratches, abrasions or other disfigurements must be properly prepared and touched-up. Remove foreign matter from prime coats before proceeding with subsequent coats. Spot priming must be featheredged into adjacent coatings to produce a smooth and level surface.

3.3 APPLICATION

3.3.1 Prime Coat

Miscellaneous metal, hollow metal doors and frames, and other materials which have been prime coated must be touched-up where the shop coat has been damaged by welding or abrasion during the handling and erection operations. Touch-up primed fasteners and welds which are unpainted after assembly and erection.

3.3.2 Coating Application

Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coating before applying subsequent coats. Interior areas must be broom clean and dust free before and during the application of coating material.

3.3.2.1 Drying Time

Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying. Provide each coat in specified condition to receive next coat.

3.3.2.2 Primers and Intermediate Coats

Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by the manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coats. Each coat must cover the surface of the preceding coat or surface completely, and there must be a visually perceptible difference in shades of successive coats.

3.3.2.3 Finished Surfaces

Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

3.3.3 Paint Utensils

Paint must be applied by a brush, roller or spray in accordance with the manufacturer's directions. Use the type of brushes best suited for the type of materials being applied. For covers on rollers use carpet with velvet back and of high pile sheep's wool or use short hair covers, as best suited for material specified.

3.3.4 Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the PM Designee to use thinners. The written permission must include quantities and types of thinners to use.

3.3.5 Minimum Dry Film Thickness (DFT)

Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise. Coating thickness where specified, refers to the minimum dry film thickness.

3.3.6 Coatings for Surfaces not Specified Otherwise

Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

3.3.7 Existing Surfaces Damaged

During performance of the work, including new patches in existing surfaces, coat surfaces with the following:

One coat of primer.

One coat of undercoat or intermediate coat.

One top coat to match adjacent surfaces.

3.3.8 Paint Techniques

Each coat of paint must be applied smoothly, worked out evenly and allowed to dry completely before the subsequent coat is applied. Finished work must be uniform and of the specified color. Paint must completely cover, be smooth and free from runs, sags, clogging or excessive flooding. Make edge of paint adjoining other materials or colors sharp and clean without overlapping. Where high gloss enamel is used, lightly sand undercoat to obtain a smooth finish coat. Painting must be completed according to the manufacturer's written instructions. Apply spray paint uniformly with suitable equipment. Paint must be applied to a minimum dry film thickness of five mils. Tint each coat of paint slightly lighter or darker than the preceding coat or the finish coat.

3.3.9 Commencement

Painting must commence when other operations detrimental to finish painting have been completed and the areas have been approved for painting.

3.3.10 Precautions

Soiled cleaning rags and waste must be disposed of daily at the close of each day's work or stored in metal containers with tight fitting covers. An appropriate number of sand buckets must be provided at all times for use in the event of fire. "No Smoking" signs must be posted as required or directed.

3.3.11 Exterior Ferrous Metal Surfaces

3.3.11.1 Hollow metal doors and frames; metal wall panels; handrails

Coatings:

1st Coat Galvanized metal primer

2nd Coat Exterior ferrous metal paint

3rd Coat Exterior ferrous metal paint

3.3.12 Interior Surfaces

3.3.12.1 Gypsum Board

Coatings:

1st Coat Latex wall primer

2nd Coat Latex flat

3rd Coat Latex flat

3.3.12.2 Ferrous Metal

Structural steel, hollow metal doors and frames (Dark Brown), galvanized metal conduit, underside of galvanized metal deck, exposed metal plates, angles, shapes, hangers, and dampers must be painted as follows:

1st Coat Metal primer (if not shop primed)

1st Coat (galvanized) Galvanized metal primer

2nd Coat Enamel undercoat

3rd Coat Enamel

3.4 FINAL CLEANING

Upon completion of work, remove staging, scaffolding and containers from the site. Remove paint spots, oil or stains from floors and other surfaces not to be painted, and leave facility clean and acceptable to the PM Designee.

--End of Section--

**SECTION 12 21 00
WINDOW BLINDS**

PART 1 GENERAL

1.1 SUMMARY

Provide window treatment, conforming to NFPA 701, complete with necessary brackets, fittings, and hardware. Provide each window treatment type as a complete unit. Mount and operate equipment in accordance with manufacturer's instructions. Completely cover windows to receive a treatment.

1.2 REFERENCES

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.

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(2023; ERTA 1 2023) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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UL SOLUTIONS (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings

Installation

SD-03 Product Data

Window Blinds; G

Recycled Content for aluminum components; S

SD-04 Samples

Window Blinds; G

SD-06 Test Reports

Window Blinds

SD-07 Certificates

Indoor Air Quality for window blinds; S

SD-08 Manufacturer's Instructions

Window Blinds; G

SD-10 Operation and Maintenance Data

Window Blinds; G

1.4 CERTIFICATIONS

1.4.1 Window Blinds

Provide products certified to meet indoor air quality requirements by UL 2818 Greenguard Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. Unless otherwise indicated, all parts will be the same color and will match the

color of the blind slat. Treat steel features for corrosion resistance. Submit product data and samples of each type and color of window treatment. Provide samples 6 inch in length for each color. Window blinds must meet emissions requirements of CDPH SECTION 01350 (use the office or classroom requirement, regardless of space type). Provide certification or validation of indoor air quality for window blinds.

Provide Aluminum Components with a minimum of 24 percent recycled content. Provide data identifying percentage of recycled content for aluminum components.

Provide certification of indoor air quality for window blinds.

2.1.1 Horizontal Blinds

Provide horizontal blinds with 2 inch slats. Blind units must be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds must be inside mount. Provide tapes for 2 inch slats with longitudinal reinforced vinyl plastic in 1-piece turn ladder construction.

2.1.1.1 Head Channel and Slats

Provide head channel made of steel or aluminum with corrosion-resistant finish nominal 0.018 inch for 2 inch slats. Provide slats of aluminum, not less than 0.006 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.

2.1.1.2 Controls

A transparent tilting wand will be provided to tilt the slats, it will hang vertically by its own weight, and will swivel for easy operation. Provide a tilter control of enclosed construction. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life. The tilter will tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. Include a mechanism to prevent over tightening. Provide a wand of sufficient length to reach to within 5 feet of the floor. Provide cordless blinds or blinds with cords that are out of reach of children and strangle proof.

2.1.1.3 Intermediate Brackets

Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over 48 inch wide.

2.1.1.4 Bottom Rail

Provide bottom rail made of corrosion-resistant steel with factory applied finish. Provide closed oval shaped bottom rail with double-lock seam for maximum strength. Bottom rail and end caps to match slats in color.

2.1.1.5 Braided Ladders

Provide braided ladders of 100 percent polyester yarn, color to match the slat color. Space ladders 15.2 slats per foot of drop in order to provide

a uniform overlap of the slats in a closed position.

2.1.1.6 Hold-Down Brackets

Provide universal type hold-down brackets for sill or jamb mount where indicated on placement list.

2.1.2 Light Control and Privacy Blinds

In addition to requirements for horizontal blinds, provide each unit with a feature that offers hidden slat holes for maximum light control and privacy.

2.1.3 Vertical Blinds

Provide vertical blind units capable of nominal 180 degree partial tilting operation and full stackback. Provide blinds that are listed by the manufacturer as designed for heavy duty strength applications including heavy duty hardware. Provide wall mounted vertical blinds with inside brackets. Provide blinds that are sill length. Outside mount type installation must provide adequate overlap to control light and privacy.

2.1.3.1 Louvers

Provide louvers which are fire resistant , UV stable, and impact resistant. Provide a weight at the bottom of the louver which are groover extruded with clear non-yellowing channel lips to accept inserts. Louvers that are 2 inch must overlap not less than 1/4 inch and be dimensionally stable.

2.1.3.2 Carriers

Provide carriers to support each louver made of molded plastic to transverse on self-fabricated wheels for smooth, easy operation. The hook of the carrier must have an automatic latch to permit easy installation and removal of the louver, and to securely lock the louver for tilting and traversing.

2.1.3.3 Headrail System

Provide headrail system not less than 0.047 inch thick and made of anodized aluminum alloy or 0.027 inch thick phosphate treated steel with a baked on ivory gloss enamel paint finish. Provide a headrail that extends the full width of the blind and can be closed with an end cap at each end. One cap will contain the traversing and tilting controls. The opposite cap will house the pulley for the traversing cord.

2.1.3.4 Valance

Attach the manufacturer's standard valance to the headrail by metal or plastic holders which grip the top and bottom edge of the valance and accept an insert of the same material as the slats. Provide sufficient clearance behind the valance to permit the louvers to tilt without interference. Extend the headrail cover the full width of the blind.

2.1.3.5 Controls

Provide tilting and traversing controls that hang compactly at the side of the blinds and reach within 5 feet of the floor. Provide tilt/traverse

control that tilts all vanes simultaneously to any desired angle and hold them at that angle. Provide a fiberglass wand that tilts the louvers by turning the wand and traverses the louvers by using the wand as a control. Sliding glass doors will have a one way draw with stackback occurring opposite door openings.

2.1.3.6 Connectors and Spacers

The connector must be flexible, smooth and flat to slide unhindered when carriers move independently of each other, and to nest compactly when carriers are stacking. Relate the length of the links to the louver width in order to equally space the traversing louvers, to maintain uniform and adequate overlap of louvers, and to fully cover the width of the opening.

2.1.3.7 Intermediate Brackets

Provide intermediate installation brackets for blinds over 62 inches wide.

2.2 COLOR

Provide color, pattern and texture selected from manufacturer's standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Submit drawings showing fabrication and Installation details. Show layout and locations of track, direction of draw, mounting heights, and details. Provide Manufacturer's Instructions and Operation and Maintenance Data. Perform installation of window blinds in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, inspect window treatments for soiling, damage or blemishes; and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, must be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include

all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

1.2.1 Feature Coordination:

Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

- 1.2.1.1 Torque, speed, and horsepower requirements of the load.
- 1.2.1.2 Ratings and characteristics of supply circuit and required control sequence.
- 1.2.1.3 Ambient and environmental conditions of installation location.

1.3 REFERENCE STANDARDS

National Electrical Manufacturers' Association (NEMA)

NEMA MG-1	Motors and Generators
NEMA MG-10	Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 841	Severe Duty, TEFC, Squirrel Cage Motors Up to and Including 370 KW (500 HP)
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PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

2.1.1 Compliance with This Section:

Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

2.1.2 Compliance with NEMA MG-1

Comply with NEMA MG-1 unless otherwise indicated.

2.1.3 Compliance with NEMA MG-10

Comply with NEMA MG-10 Energy Management Guide For Selection and use of

Polyphase Motors.

2.1.4 Compliance with IEEE 841

Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

2.2.1 Duty:

Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

2.2.2 Capacity and Torque Characteristics:

Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

2.3.1 Larger Motors:

Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

2.3.1.1 Permanent-split capacitor.

2.3.1.2 Split phase.

2.3.1.3 Capacitor start, inductor run.

2.3.1.4 Capacitor start, capacitor run.

2.3.1.5 Electronically Commutated Motor (ECM)

2.3.2 Multispeed Motors:

Variable-torque, permanent-split-capacitor type or ECM.

2.3.3 Bearings:

Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

2.3.4 Motors 1/20 HP and Smaller:

Shaded-pole type.

2.3.5 Thermal Protection:

Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device must automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes the following hangers and supports for HVAC system piping and equipment:

1.1.1.1 Metal framing systems.

1.1.1.2 Fastener systems.

1.1.1.3 Equipment supports.

1.2 DEFINITIONS

1.2.1 MSS:

Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

1.2.2 Terminology:

As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Pipe Supports:

Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

1.3.2 Equipment Supports:

Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3.3 Seismic-Restraint Hangers and Supports:

Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

SD-02 Shop Drawings: Signed and sealed by a qualified Licensed Professional Engineer. Show fabrication and installation details and include calculations for the following:

1. Metal framing systems. Include Product Data for components.

2. Equipment supports.

SD-07 Certificates

Welding certificates.

1.5 QUALITY ASSURANCE

1.5.1 Welding:

Qualify procedures and personnel according to the following:

1.5.1.1 AWS D1.1, "Structural Welding Code--Steel."

1.5.1.2 AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5.1.3 AWS D1.4, "Structural Welding Code--Reinforcing Steel."

1.5.1.4 ASME Boiler and Pressure Vessels Code (BPVC): Section IX.

1.6 REFERENCE STANDARDS

American Society for Mechanical Engineers(ASME)

ASME B31.1	Power Piping
ASME B31.9	Building Services Piping
ASME BPVC	ASME Boiler and Pressure Vessels Code

ASTM International (ASTM)

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

American Welding Society (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D1.3	Structural Welding Code - Sheet Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel

Metal Framing Manufacturers' Association (MFMA)

MFMA-4	Metal Framing Standards Publication
MFMA-103	Guidelines for the Use of Metal Framing

Manufacturers' Standardization Society for the Valve and Fitting Industry, Inc. (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection,
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2.4.2.1 Properties:

Nonstaining, noncorrosive, and nongaseous.

2.8.2.2 Design Mix:

5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

3.1.1 Specific Requirements:

Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

3.1.2 Compliance with MSS SP-69:

Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

3.1.3 Galvanized, Metallic Coatings:

Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

3.1.4 Nonmetallic Coatings:

Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

3.1.5 Padded clamps:

Use padded clamps for piping that is subject to scratching.

3.1.6 Compliance with MFMA-103:

Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

3.1.7 Mechanical Expansion Anchors

Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

3.2.1 Metal Framing System Installation:

Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

3.2.2 Fastener System Installation:

3.2.2.1 Mechanical Expansion Anchors:

Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's

written instructions.

3.2.3 Installation with Accessories:

Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

3.2.4 Equipment Support Installation:

Fabricate from welded-structural-steel shapes.

3.2.5 Hanger and Support Installation for Thermal and Seismic Movement:

Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

3.2.6 Lateral Bracing:

Install lateral bracing with pipe hangers and supports to prevent swaying.

3.2.7 Load Distribution:

Install supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.2.8 Pipe Slopes:

Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

3.3 EQUIPMENT SUPPORTS

3.3.1 Structural Steel Stands:

Fabricate structural-steel stands to support equipment above floor.

3.3.2 Grouting:

Place grout under supports for equipment and make smooth bearing surface.

3.3.3 Lateral Bracing:

Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

3.4.1 Cutting, Drilling, and Fitting:

Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

3.4.2 Exposed Connections:

Fit exposed connections together to form hairline joints. Field weld

connections that cannot be shop welded because of shipping size limitations.

3.4.3 Field Welding:

Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

3.4.3.1 Minimizing Distortion:

Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

3.4.3.2 Fusion:

Obtain fusion without undercut or overlap.

3.4.3.3 Flux:

Remove welding flux immediately.

3.4.3.4 Welds at Exposed Connections:

Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 PAINTING

3.5.1 Galvanized Surfaces:

Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

-- End of Section --

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2.1.1.4 Fasteners:

Stainless-steel rivets or self-tapping screws.

2.1.1.5 Adhesive:

Contact-type permanent adhesive, compatible with label and with substrate.

2.1.2 Plastic Labels for Equipment:

2.1.2.1 Material and Thickness:

Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

2.1.2.2 Letter Color:

White.

2.1.2.3 Background Color:

Black.

2.1.2.4 Maximum Temperature:

Able to withstand temperatures up to 160 deg F.

2.1.2.5 Minimum Label Size:

Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

2.1.2.6 Minimum Letter Size:

1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2.1.2.7 Fasteners:

Stainless-steel rivets or self-tapping screws.

2.1.2.8 Adhesive:

Contact-type permanent adhesive, compatible with label and with substrate.

2.1.3 Label Content:

Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.1.4 Equipment Label Schedule:

For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule must be included in operation and maintenance data.

2.2 PIPE LABELS

2.2.1 General Requirements for Manufactured Pipe Labels:

Preprinted, color-coded, with lettering indicating service, and showing flow direction.

2.2.2 Pretensioned Pipe Labels:

Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

2.2.3 Self-Adhesive Pipe Labels:

Printed plastic with contact-type, permanent-adhesive backing.

2.2.4 Pipe Label Contents:

Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

2.2.4.1 Flow-Direction Arrows:

Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2.2.4.2 Lettering Size:

At least 1-1/2 inches high.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Cleaning:

Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

3.2.1 Labeling:

Install or permanently fasten labels on each major item of mechanical equipment.

3.2.2 Location:

Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

3.3.1 Location:

Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

3.3.1.1 Valve and Control Device Locations:

Near each valve and control device.

3.3.1.2 Branch Connection Locations:

Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3.3.1.3 Penetration Locations:

Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

3.3.1.4 Access Locations:

At access doors, manholes, and similar access points that permit view of concealed piping.

3.3.1.5 Major Equipment Locations:

Near major equipment items and other points of origination and termination.

3.3.1.6 Spacing:

Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.3.2 Pipe Label Color Schedule:

Provide colors per ANSI/ASME A13.1.

-- End of Section --

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Line Test Pressure for Refrigerant Pipe: The design pressures for line testing must be the test pressure listed on the label nameplate of the condensing unit, compressor, compressor unit, pressure vessel or other system component with a nameplate.

1.3 SUBMITTALS

SD-02 Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

Shop Drawing Scale: 1/4 inch equals 1 foot.

Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

SD-03 Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

- Thermostatic expansion valves
- Solenoid valves
- Hot-gas bypass valves
- Filter dryers
- Strainers
- Pressure-regulating valves

SD-06 Test Reports

Field quality-control test reports

SD-07 Certificates

Welding certificates

SD-10 Operation and Maintenance Data:

For refrigerant valves and piping specialties to include in maintenance manuals.

1.4 QUALITY ASSURANCE

1.4.1 Welding:

Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1.4.2 Compliance with ASHRAE 15:

Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

1.4.3 Compliance with ASME B31.5:

Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.6 COORDINATION

Coordinate size and location of equipment supports..

1.7 REFERENCE STANDARDS

Air-conditioning, Heating, and Refrigeration Institute (AHRI)

AHRI 495	Performance Rating of Refrigerant Liquid Receivers
AHRI 730	Flow Capacity Rating and Application of Suction-Line Filters and Filter-Driers
AHRI 750	Performance Rating of Thermostatic Refrigerant Expansion Valves
AHRI 760	Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

American Society for Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE)

ASHRAE 15	Safety Standard for Refrigeration Systems
ASHRAE 34	Designation and Safety Classification of Refrigerants

American Society of Mechanical Engineers (ASME)

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ASME B31.5	Refrigeration Piping and Heat Transfer Components

ASTM International (ASTM)

ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A234	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM B32	Standard Specification for Solder Metal
ASTM B280	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

American Welding Society (AWS)

AWS A5.8	Specification for Filler Metals for Brazing and Braze Welding
AWS D10.12	Guide for Welding Mild Steel Pipe

Manufacturers' Standardization Society for the Valve and Fitting Industry, Inc. (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
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National Electrical Manufacturers' Association (NEMA)

NEMA 250	Standard for Enclosures for Electrical Equipment (1,000 Volts Maximum)
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Underwriters' Laboratories (UL)

UL 207	Refrigerant-Containing Components and Accessories, Non-electrical
UL 429	Standard for Electrically Operated Valves

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

2.1.1 Copper Tube:

ASTM B280, Type ACR.

2.1.2 Wrought-Copper Fittings:

ASME B16.22.

2.1.3 Wrought-Copper Unions:

ASME B16.22.

2.1.4 Solder Filler Metals:

ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

2.1.5 Brazing Filler Metals:

AWS A5.8.

2.1.6 Flexible Connectors:

2.1.6.1 Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

2.1.6.2 End Connections: Socket ends.

2.1.6.3 Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.

2.1.6.4 Pressure Rating: Factory test at minimum 500 psig.

2.1.6.5 Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

2.2.1 Moisture/Liquid Indicators:

2.2.1.1 Body: Forged brass.

2.2.1.2 Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.

2.2.1.3 Indicator: Color coded to show moisture content in ppm.

2.2.1.4 Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.

2.2.1.5 End Connections: Socket or flare.

2.2.1.6 Working Pressure Rating: 500 psig.

2.2.1.7 Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

2.3.1 ASHRAE 34, R-32

2.3.2 ASHRAE 34, R-454B

PART 3 EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANTS

3.1.1 Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:

3.1.1.1 NPS 1-1/2 and Smaller:

Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

3.2.1 Moisture/Liquid Indicators:

Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

3.3 PIPING INSTALLATION

3.3.1 Drawings:

Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

3.3.2 Refrigerant Piping Installation Compliance:

Install refrigerant piping according to ASHRAE 15.

3.3.3 Exposed Piping:

Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

3.3.4 Piping Adjacent to Machines

Install piping adjacent to machines to allow service and maintenance.

3.3.5 Free of Sags and Bends:

Install piping free of sags and bends.

3.3.6 Fittings:

Install fittings for changes in direction and branch connections.

3.3.7 System Component Selection:

Select system components with pressure rating equal to or greater than system operating pressure.

3.3.8 Short and Direct Piping Installation:

Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

3.3.9 Arrangement for Inspection and Service:

Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

3.3.10 Sloping:

Slope refrigerant piping as follows:

3.3.10.1 Horizontal Hot-Gas Discharge Piping: Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

3.3.10.2 Horizontal Suction Lines: Install horizontal suction lines with a uniform slope downward to compressor.

3.3.10.3 Traps and Double Risers: Install traps and double risers to entrain oil in vertical runs. Refer to manufacturer's directions.

3.3.10.4 Liquid Lines: Liquid lines may be installed level.

3.3.11 Brazing:

When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

3.3.12 Pipe and Fitting Cleaning:

Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

3.3.12.1 Piping Interior: Shot blast the interior of piping.

3.3.12.2 Coarse Particle Removal: Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.

3.3.12.3 Trichloroethylene Cloth: Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.

3.3.12.4 Compressor Oil Cloth: Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.

3.3.12.5 Dry Cloth: Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.3.12.6 Safety-Relief-Valve Discharge Piping: Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

3.3.13 Pipe Sleeves at Penetrations:

Install pipe sleeves at penetrations in exterior walls and floor assemblies.

3.3.14 Penetration Sealing through Barriers:

Seal penetrations through fire and smoke barriers.

3.3.15 Clearance:

Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

3.3.16 Sleeves through Floors, Walls, or Ceilings:

Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

3.3.17 Penetration Sealing through Exterior Walls:

Seal pipe penetrations through exterior walls according to Section 07 92 00 "Joint Sealants" for materials and methods.

3.3.18 Identification:

Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

3.4.1 Reaming, Beveling, and Burr Removal:

Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

3.4.2 Scale, Slag, Dirt, and Debris Removal:

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3.4.3 Pipe and Fitting Filling with Gas:

Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

3.4.4 Brazed Joints:

Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

3.4.4.1 Joining Copper Socket Fittings: Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

3.4.4.2 Joining Copper with Bronze or Steel: Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.4.5 Threaded Joints:

Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

3.4.5.1 Tape or Thread Compound Application: Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.

3.4.5.2 Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4.6 Joint Sealing:

Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

3.4.7 Welded Joints:

Construct joints according to AWS D10.12/D10.12M.

3.5 HANGERS AND SUPPORTS

3.5.1 Hanger, Support, and Anchor Products:

Hanger, support, and anchor products are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

3.5.2 Pipe Attachments:

Install the following pipe attachments:

3.5.2.1 Copper-Clad Hangers and Supports: Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

3.5.3 Hangers for Copper Tubing:

Install supports for copper tubing with the following maximum spacing and minimum rod sizes:

3.5.3.1 NPS 1/2: Maximum span, 60 inches

3.5.3.2 NPS 5/8: Maximum span, 60 inches.

3.6 FIELD QUALITY CONTROL

3.6.1 Test and Inspection Performance:

Perform tests and inspections and prepare test reports.

3.6.2 Tests and Inspections:

3.6.2.1 Compliance: Comply with ASME B31.5, Chapter VI.

3.6.2.2 Piping, Specialty, and Receiver Testing: Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3.6.2.3 High- and Low-Pressure Side Piping Testing: Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

- a. Fill system with nitrogen to the required test pressure.
- b. System must maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

3.7.1 Charging Procedures:

Charge system using the following procedures:

3.7.1.1 System Evacuation: Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.

3.7.1.2 Vacuum Break Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.

3.8 ADJUSTING

3.8.1 High- and Low-Pressure Switch Settings Adjustment:

Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

3.8.2 Set-Point Temperature Adjustments:

Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

3.8.3 Adjustments before Operation:

Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

3.8.3.1 Compressor Oil Level Verification: Verify that compressor oil level is correct.

3.8.3.2 Suction and Discharge Valves' Opening: Open compressor suction and discharge valves.

3.8.3.3 Refrigerant Valves' Opening: Open refrigerant valves except bypass valves that are used for other purposes.

3.8.3.4 Alignment and Lubrication Check: Check open compressor-motor alignment and verify lubrication for motors and bearings.

-- End of Section --

SECTION 23 31 13
METAL DUCTS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Single-wall rectangular ducts and fittings.

1.1.1.2 Sheet metal materials.

1.1.1.3 Duct liner.

1.1.1.4 Sealants and gaskets.

1.1.1.5 Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Delegated Duct Design:

Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, must comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1.2.2 Airstream Surfaces:

Surfaces in contact with the airstream must comply with requirements in ASHRAE 62.1.

1.3 SUBMITTALS

SD-02 Shop Drawings

Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

Factory- and shop-fabricated ducts and fittings.

Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

Elevation of top of ducts.

Dimensions of main duct runs from building grid lines.

Fittings.

Reinforcement and spacing.

Seam and joint construction.

Penetrations through fire-rated and other partitions.

Equipment installation based on equipment being used on Project.

Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

SD-03 Product Data

For each type of the following products:

Liners and adhesives.

Sealants and gaskets.

Single-Wall Rectangular Ducts And Fittings

Sheet Metal Materials

Hangers And Supports

Duct Liner

SD-05 Design Data

Delegated-Design Submittal:

Sheet metal thicknesses.

Joint and seam construction and sealing.

Reinforcement details and spacing.

Materials, fabrication, assembly, and spacing of hangers and supports.

Design Calculations: Calculations, including analysis data signed and sealed by the qualified Licensed Professional Engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

SD-06 Test Reports

Field quality-control reports.

SD-07 Certificates

Welding certificates.

1.4 QUALITY ASSURANCE

1.4.1 ASHRAE Compliance:

Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.4.2 ASHRAE/IESNA Compliance:

Applicable requirements in ASHRAE 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.5 REFERENCE STANDARDS

American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)

ASHRAE 62.1 Standard for Ventilation and Indoor Air Quality

ASHRAE 90.1 Energy Standard for Sites and Buildings

ASHRAE 111 Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems

American Society of Civil Engineers (ASCE)

ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM International (ASTM)

ASTM A36/A36M Standard Specification for Carbon Structural Steel

ASTM A603 Standard Specification for Metallic-Coated, Structural, Steel Wire Rope

ASTM A653/A653M Standard Specification for Hot-Dipped, Zinc Coated, Steel Sheet

ASTM A1008/A1008M Standard Specification for Hardened, High Strength, Structural Steel

ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C916 Standard Specification for Adhesives for Duct Thermal Insulation

ASTM C920 Standard Specification for Elastomeric Joint Sealants

ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation

ASTM D3363 Standard Test Method for Film Hardness

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E488 Standard Test Method for Strength of Anchors in Concrete Elements

American Welding Society (AWS)

AWS D1.1/D1.1M Structural Steel Welding Code

AWS D9.1/D9.1M Sheet Metal Welding Code

National Air Duct Cleaners Association (NADCA)

NADCA (2005) Introduction to HVAC System
Cleaning Services

NADCA ACR (2021) Assessment, Cleaning, and
Restoration of HVAC Systems

North American Insulation Manufacturers Association (NAIMA)

NAIMA AH124 Fibrous Glass Duct Liner Standard

National Fire Protection Agency (NFPA)

NFPA 90A Standard for the Installation of
Air-Conditioning and Ventilating Systems

NFPA 90B Standard for the Installation of Warm Air
Heating and Air-Conditioning Systems

Sheet Metal and Air-conditioning Contractors' National Association
(SMACNA)

ANSI/SMACNA 001-2008 (2008) Seismic Restraint Manual:
Guidelines for Mechanical Systems, 3rd
Edition

ANSI/SMACNA 006-2020 (2020) HVAC Duct Construction Standards -
Metal and Flexible, 4th Edition

ANSI/SMACNA 016-2012 (2012) HVAC Air Duct Leakage Test Manual,
2nd Edition

Underwriters Laboratories (UL)

UL 723 Standard Test Method for Surface Burning
Characteristics of Building Materials

PART 2 PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

2.1.1 General Fabrication Requirements:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

2.1.2 Transverse Joints:

Select joint types and fabricate according to ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible."

2.1.3 Longitudinal Seams:

Select seam types and fabricate according to ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible."

2.1.4 Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction

Select types and fabricate according to ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

2.2.1 General Material Requirements:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2.2 Galvanized Sheet Steel:

Comply with ASTM A653/A653M.

2.2.2.1 Galvanized Coating Designation:

G90.

2.3 DUCT LINER

2.3.1 Fibrous-Glass Duct Liner:

Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

2.3.1.1 Maximum Thermal Conductivity:

Types:

- a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2.4 HANGERS AND SUPPORTS

2.4.1 Hanger Rods for Noncorrosive Environments:

Cadmium-plated steel rods and nuts.

2.4.2 Strap and Rod Sizes:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

2.4.3 Steel Cables for Galvanized-Steel Ducts:

Galvanized steel complying with ASTM A603.

2.4.4 Steel Cable End Connections:

Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

2.4.5 Duct Attachments:

Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.4.6 Trapeze and Riser Supports:

2.4.6.1 Supports for Galvanized-Steel Ducts:

Galvanized-steel shapes and plates.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

3.1.1 Drawing Plans:

Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

3.1.2 SMACNA Compliance:

Install ducts according to ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

3.1.3 Round Ducts:

Install round ducts in maximum practical lengths.

3.1.4 Minimize Joints:

Install ducts with fewest possible joints.

3.1.5 Factory- or Shop-Fabricated Fittings:

Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

3.1.6 Duct Clearance:

Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

3.1.7 Duct Interior Protection:

Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

3.2.1 Sealing:

Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible."

3.3 HANGER AND SUPPORT INSTALLATION

3.3.1 SMACNA Compliance:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

3.3.2 Hanger Spacing:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

3.3.3 Vertical Duct Support:

Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

3.3.4 Upper Attachments:

Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

3.4.1 SMACNA Compliance:

Comply with ANSI/SMACNA 006-2020 "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

3.5.1 Perform tests and inspections.

3.5.2 Leakage Tests:

3.5.2.1 SMACNA Compliance:

Comply with ANSI/SMACNA 016-2012 "HVAC Air Duct Leakage Test Manual."
Submit a test report for each test.

3.5.2.2 Leak Testing:

Test for leaks before applying external insulation.

3.5.2.3 Static Pressure Tests:

Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

3.5.2.4 Notice:

Give seven days' advance notice for testing.

3.5.3 Duct System Cleanliness Tests:

3.5.3.1 Visual Inspection:

Visually inspect duct system to ensure that no visible contaminants are present.

3.5.3.2 Section Testing:

Test sections of metal duct system, chosen randomly by PM Designee, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

- a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media must not exceed 0.75 mg/100 sq. cm.

3.5.4 Disposition:

Duct system will be considered defective if it does not pass tests and inspections.

3.5.5 Field Quality-Control Reports:

Prepare test and inspection reports.

3.6 DUCT CLEANING

3.6.1 System Cleaning:

Clean duct system(s) before testing, adjusting, and balancing.

3.6.2 Component Cleaning:

Clean the following components by removing surface contaminants and deposits:

3.6.2.1 Airways:

Air outlets and inlets (registers, grilles, and diffusers).

3.6.2.2 Fans:

Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3.6.2.3 Air-Handling Unit Components:

Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

3.6.2.4 Coils:

Coils and related components.

3.6.2.5 Dedicated Exhaust and Ventilation Components and Makeup Air Systems

3.6.3 Mechanical Cleaning Methodology:

3.6.3.1 Cleaning Metal Duct Systems:

Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

3.6.3.2 Vacuum-Collection Devices:

Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3.6.3.3 Mechanical Agitation:

Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

3.6.3.4 Cleaning Coils and Drain Pans:

Clean coils and coil drain pans according to NADCA. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

3.6.3.5 Drainage and Cleanup:

Provide drainage and cleanup for wash-down procedures.

-- End of Section --

SECTION 23 81 26
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

SD-02 Shop Drawings:

Diagram power, signal, and control wiring.

SD-03 Product Data:

Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

SD-04 Samples

Samples for Initial Selection: For units with factory-applied color finishes.

SD-06 Test Reports

Field quality-control test reports.

SD-10 Operation and Maintenance Data:

For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

SD-11 Closeout Submittals:

Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

1.3.1 Product Options:

Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated.

1.3.2 Electrical Components, Devices, and Accessories:

Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3.3 ASHRAE Compliance:

Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

1.3.4 ASHRAE/IESNA 90.1 Compliance:

Applicable requirements in ASHRAE 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

1.4.1 Special Warranty:

Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1.4.1.1 Warranty Period: 1 year from date of Substantial Completion.

1.5 EXTRA MATERIALS

1.5.1 Furnishing Extra Materials:

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5.1.1 Filters: One set of filters for each unit.

1.6 REFERENCE STANDARDS

AHRI - Air Conditioning, Heating, and Refrigeration Institute
AHRI 210/240 Performance Rating of Unitary
Air-conditioning and Air-source Heat Pump
Equipment

ASHRAE - American Society of Heating, Refrigeration, and Air
Conditioning Engineers
ASHRAE 52.2 Method of Testing General Ventilation
Air-Cleaning Devices for Removal
Efficiency by Particle Size
ASHRAE 62.1 Ventilation and Acceptable Indoor Air
Quality
ASHRAE 90.1 Energy Standard for Buildings Except
Low-Rise Residential Buildings

PART 2 PRODUCTS

2.1 CEILING-MOUNTING, EVAPORATOR-FAN COMPONENTS

2.1.1 Cabinet:

Enameled steel with removable panels on front and ends in color selected by COR, and discharge drain pans with drain connection.

2.1.1.1 Airstream Surfaces: Surfaces in contact with the airstream must comply with requirements in ASHRAE 62.1.

2.1.1.2 Drain Pan and Drain Connection: Comply with ASHRAE 62.1.

2.1.2 Refrigerant Coil:

Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.

2.1.3 Electric Coil:

Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

2.1.4 Fan:

Direct drive, centrifugal fan, with power-induced outside air, and integral condensate pump.

2.1.5 Filters:

Manufacturer provided, washable.

2.2 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

2.2.1 Casing:

Steel, finished with baked enamel in color selected by COR, with removable panels for access to controls, weep holes for water rainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2.2.2 Compressor:

Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor must have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

2.2.2.1 Compressor Type: Reciprocating or Scroll.

2.2.2.2 Compressor Spec: Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

2.2.2.3 Refrigerant: R-454B or R-32.

2.2.3 Refrigerant Coil:

Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.

2.2.4 Heat Pump Components:

Reversing valve and low-temperature air cut-off thermostat.

2.2.5 Fan:

Aluminum-propeller type, directly connected to motor.

2.2.6 Motor:

Permanently lubricated, with integral thermal-overload protection.

2.2.7 Low Ambient Kit:

Permits operation down to 0 deg F.

2.2.8 Mounting Base:

Polyethylene.

2.2.9 Minimum Energy Efficiency:

Comply with ASHRAE 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.3 ACCESSORIES

2.3.1 Thermostat:

Low voltage with subbase to control compressor and evaporator fan.

2.3.2 Thermostat:

Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

2.3.2.1 Delay: Compressor time delay.

2.3.2.2 Time Clock: 24-hour time control of system stop and start.

2.3.2.3 LCD: Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

2.3.2.4 Speed: Fan-speed selection, including auto setting.

2.3.3 Short Cycling:

Automatic-reset timer to prevent rapid cycling of compressor.

2.3.4 Refrigerant Line Kits:

Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

2.3.4.1 Minimum Insulation Thickness: 1 inch thick.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Unit:

Install units level and plumb.

3.1.2 Fan:

Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

3.1.3 Concrete Base:

Install ground-mounting, compressor-condenser components on minimum 3 -inch- thick, prefabricated concrete base; 4 inches larger on each side than unit.

3.1.4 Seismic:

Install seismic restraints.

3.1.5 Restraints:

Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch.

3.1.6 Charge:

Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 FIELD QUALITY CONTROL

3.2.1 Manufacturer's Field Service:

Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

3.2.2 Perform the following field tests and inspections and prepare test reports:

3.2.2.1 Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.2.2.2 Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.2.2.3 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.3 STARTUP SERVICE

3.3.1 Engage a factory-authorized service representative to perform startup service.

3.3.1.1 Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

3.4.1 Engage a factory-authorized service representative to train FAA's maintenance personnel to adjust, operate, and maintain units.

-- End of Section --

**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 General:

The general electrical requirements in this section are applicable to both Parsons' Furnished Equipment and non-Parsons' furnished equipment. Materials and equipment must comply with requirements of the contract documents. Materials provided must be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If material and equipment requirements conflict, the order of precedence for selection must be as follows:

- 1.1.1.1 Special Contract Provisions.
- 1.1.1.2 The contract specifications.
- 1.1.1.3 Federal Aviation Administration (FAA) specifications and standards.
- 1.1.1.4 Contract drawings.
- 1.1.1.5 Military Specifications.
- 1.1.1.6 Federal Specifications.
- 1.1.1.7 NFPA-70 National Electrical Code.
- 1.1.1.8 IEEE Standards.
- 1.1.1.9 NRTL Standards and NEMA Standards.

1.2 REFERENCES

American National Standards Institute (ANSI)

ANSI A13.1	Scheme for the Identification of Piping Systems
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Federal Aviation Administration (FAA)

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment, latest edition
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FAA-C-1217	Electrical Work, Premises Wiring, latest edition
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FAA-C-1391	Installation, Termination, Splicing, and Transient/Surge Protection of Underground Electrical Distribution System Power Cables, latest edition
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will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified. Submit samples of color, lettering style, and other graphic representation required for each identification product for the project.

1.5 QUALITY ASSURANCE

1.5.1 Compliance:

Comply with latest editions of NFPA 70, FAA-STD-019, FAA-C-1391, FAA-C-1217, FAA JO 6000.204, FAA JO 6850.5D, and FAA JO 6950.22A. for components and installation. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement must apply.

1.5.2 Listing and Labeling:

Provide products specified in the Section that are listed and labeled. The terms "listed and labeled" as defined in the latest edition of NFPA 70, National Electrical Code, Article 100.

1.5.3 Project Record Documents:

Maintain at the job site a separate set of white prints of the contract documents for the purpose of recording the system and dimension changes of those portions of work in which actual construction is at variance with the contract documents. Record changes for all equipment whether provided by Parsons or otherwise. Upon acceptance of the project, submit documents to the Resident Engineer, with verification of data accuracy. Mark the drawings with colored pencil. Prepare the drawings as the work progresses. Upon completion of work submit drawings clearly indicating the following:

Locations of devices, raceways, equipment and other pertinent items. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings and the cable and raceway schedule. The drawings must be detailed to wire and terminal block numbers, conductor color coding, device designations locations and reflect identifications established at the site.

Cable and raceway schedule for cables and raceways actually installed; include the type, size, origin, destination, and approximate length for each cable and raceway.

1.6 DELIVERY, STORAGE AND HANDLING

All provided equipment must be protected from damage and stored in a dry location from the time of site delivery. Conduct routine inspections of stored equipment to check equipment condition. Follow the Manufacturer s directions for the delivery, storage, and handling of equipment and materials. Tightly cover equipment and materials and protect from dirt, water, chemical or mechanical injury and theft. Damaged equipment and material will not be acceptable. Upon installation, protect the equipment and materials until work is completed and accepted by the Contractor and the FAA.

PART 2 PRODUCTS

2.1 SUPPORTING DEVICES

2.1.1 Supports, Sleeves, and Fasteners:

Channel and angle supports, raceway supports, sleeves and fasteners must be as specified in Section 26 05 29, Hangers and Supports for Electrical Systems.

2.2 ELECTRICAL IDENTIFICATION

Provide electrical identification as specified in Section 26 05 53, Identification for Electrical Systems. Manufacturer's standard products to use colors prescribed by ANSI A13.1 and NFPA 70, latest edition.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 NECA Compliance:

Comply with NECA 1, Good Workmanship in Electrical Construction.

3.1.2 Materials and Equipment:

Materials and equipment must be installed in accordance with the contract drawings. Where manufacturer's recommended installation methods conflict with the contract requirements, difference must be resolved by the Resident Engineer. The installation must be accomplished by skilled workers regularly engaged in this type of work. A licensed Master Electrician must be required for all electrical equipment installation, raceway installation, wiring, and electrical tests. Electrical Apprentices may be used under the direct supervision of a Master Electrician.

3.2 INSTALLATION

3.2.1 Rules, Regulations, and Reference Documents:

The rules, regulations, and reference documents indicated must be considered as minimum requirements. Furnishing and installing higher grades of materials and workmanship than are specified or when required by the contract drawings is permitted. Equipment must be installed in a manner to provide proper working space, access, and space for removal of the equipment to suit intended application.

3.2.2 Contract Drawings:

Where the drawings schematically indicate the work, diagrammatically or otherwise, furnish and install equipment, material and labor for a complete and proper installation. Ensure that electrical and communications work is coordinated and compatible with Architectural, Mechanical, Structural, and Civil work.

3.2.3 Fastening:

Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.

3.2.4 Identification Devices:

Install identification devices where required in accordance with the requirements of Section 26 05 53, Identification for Electrical Systems.

3.3 DEMOLITION

3.3.1 Protection of Existing Facilities:

Protect existing electrical equipment and installations when performing new work. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality. Remove demolished material from the project site. Remove, store, clean, re-install, reconnect, and make operational components indicated for relocation.

3.3.2 Accessible Work:

Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

3.4 CUTTING AND PATCHING

Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved. Repair disturbed surfaces to match adjacent undisturbed surfaces.

-- End of Section --

International Electrical Testing Association (NETA)

NETA ATS Acceptance Testing Specification for
Electric Power Distribution Equipment and
Systems

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code (NEC), latest
edition

Occupational Safety and Health Administration (OSHA)

29CFR1910.7 Definitions and Requirements for a
Nationally Recognized Testing Laboratory
(NRTL)

UL Solutions (UL)

UL 486A Wire Connectors and Soldering Lugs for Use
with Copper Conductors

UL 486C Splicing Wire Connectors

UL 486E Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors

Insulated Cable Engineers Association (ICEA)

ICEA S-84-608 Telecommunications Cable Filled,
Polyolefin Insulated, Copper Conductor
Technical Requirements

National Electrical Contractors Association (NECA)

NECA 1 Standard for Good Workmanship in
Electrical Construction

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in
accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-03 Product Data:

Submit product data for each product specified.

Specifications: Submit manufacturer's data on electric wire, cables,
conductors, connectors, and connector crimping tools where
specified.

SD-06 Test Reports

Field Test Reports: Submit field test reports indicating and
interpreting test results relative to compliance with the
performance requirements of the testing standard.

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.4 QUALITY CONTROL

1.4.1 NFPA Compliance

Comply with NFPA 70, NEC, latest edition, for components and installation.

1.4.2 Listing and Labeling

Provide products specified in this Section that are listed and labeled.

1.4.2.1 The Terms "Listed and Labeled":

As defined in the NEC, Article 100.

1.4.2.2 Listing and Labeling Agency Qualifications:

An NRTL as defined in OSHA Regulation 29CFR1910.7.

1.4.3 Installer Qualifications

Cable splices must be performed by experienced and qualified cable splicers. The workers must be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

1.5.1 Coordination

Coordinate layout and installation of cable with other installations.

1.5.1.1 Locations and Elevations:

Revise locations and elevations from those indicated as required to suit field conditions in coordination with the PM Designee.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver all wire and cable products to the Project site in accordance with NEMA WC26 and in their original packaging. Conductors with damaged insulation must not be permitted.

1.6.2 Storage

Store wire and cable products in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

1.6.3 Handling

Handle wire and cable products carefully to avoid abrading, puncturing, or tearing wire and cable insulation and sheathing. Ensure that the dielectric resistance integrity of wire/cable is maintained.

SECTION 26 05 00.10
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 WORK INCLUDES

1.1.1 General

1.1.1.1 Furnishing:

Furnish material, equipment, labor and incidentals necessary for complete and operational systems as specified herein.

1.1.1.2 Related Sections:

This section concerns all other sections in Division 26 and must be considered a part of each of those sections as if written in their entirety.

1.1.1.3 General Electrical Requirements:

The general electrical requirements in this section are applicable to both Government Furnished Equipment (GFE) and non-GFE equipment.

1.1.1.4 Order of Precedence:

Materials and equipment must comply with all requirements of the contract documents. Materials furnished by the subcontractor must be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If electrical material and equipment requirements conflict, the order of precedence for selection must be as follows: FAA Specifications and Standards, Contract Specifications, Contract Drawings. And then in continuing order of precedence, Military Specifications, Federal Specifications, NFPA 70 "National Electrical Code", IEEE Standards, Nationally Recognized Testing Laboratory (NRTL) Standards and NEMA Standards.

1.1.1.5 Replacement and Spare Parts:

Replacement and spare parts must be provided as indicated in other sections of Division 26.

1.1.1.6 Electrical Equipment and Systems:

Provide the following electrical equipment and systems:

Equipment, wiring devices, and electrical connections required for installation of electrical equipment.

- a. Grounding systems
- b. Cutting and patching for electrical construction

1.1.1.7 Minor Departures:

Minor departures from exact dimensions shown in electrical plans may be permitted where required to avoid conflict or unnecessary difficulty in

1.3 JOB CONDITIONS

1.3.1 Permits, Licenses, and Inspection:

Obtain and pay for all permits, licenses, and inspection completion as required by law for the completion of the work. Certificates of approval must be secured, paid for and delivered to the Contractor before receiving the acceptance of the work.

1.3.2 Material, Equipment, Device, and Appliance Locations:

The location of materials, equipment, devices, and appliances indicated are approximate and subject to revisions at the time of installation. The Contract Drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.3.3 Rearrangement:

Should project conditions require any rearrangement of work, or if equipment or accessories can be installed to a better advantage than the general arrangement of work on the plans, the Subcontractor may, before proceeding with the work, prepare and submit plans of the proposed rearrangement to the PM Designee.

1.3.4 Equipment Size:

Electrical equipment size indicated on the Contract Drawings is based on a particular manufacturer. It is the responsibility of the Subcontractor to verify that the equipment he proposes to furnish will fit in the space indicated on the Drawings.

1.3.5 Equipment Coordination:

Equipment furnished and installed under other Sections of this Specification and by the Contractor must be coordinated with equipment furnished and installed under this section.

1.3.6 Electrical Work Supervision:

Electrical work must be performed under the supervision of a master Electrician who holds a valid license.

1.3.7 Code Violations:

Perform work to meet or exceed the requirements of the National Electrical Code and other applicable statutes, ordinances, codes, and regulations of the governmental authorities having jurisdiction. Resolve any code violations discovered in the Contract Documents with the Subcontracts Administrator prior to award of the Contract. After the award of the Contract, make any corrections or additions necessary for the compliance with applicable codes at no additional cost to the Contractor or to the Government.

1.4 GUARANTEES

The work must be guaranteed for one year from the date of final acceptance of the project and during that period the Subcontractor must make repair

at its own expense any faults or imperfections that may rise due to defects of omissions in materials or workmanship.

1.5 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Equipment and Principal Materials: Within 5 days after the Notice of Award (NOA) of the contract and before orders are placed or shop drawings are submitted, submit to the PM Designee a list of equipment and principal materials specified. Give names and manufacturer's catalog and model numbers and other such supplemental information as necessary for identification.

SD-03 Product Data

Manufacturer's Data Sheets: Component catalog numbers and manufacturer's data sheets, including pertinent data identifying each component by the item number and nomenclature, as specified.

SD-04 Samples

When the adequacy, quality, and safety of a material will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified.

SD-06 Test Reports

Submit a Summary of the Electrical Test Report and Motor Test Report, noting deviations from requirements listed below:

1. Maximum plus or minus five percent variation between nominal system voltage and no load voltage;
2. Maximum plus or minus ten percent variation between average phase current and measured individual phase currents for panelboards.

SD-11 Closeout Documents

Project Record Documents: Maintain at the job site a separate set of redline bond prints of the Contract Documents (specifications, drawings, change orders, addendums) for the purpose of recording the system and dimension changes of those portions of work in which actual construction is significantly at variance with the Contract Documents. Record changes for both GFE and Subcontractor provided equipment. Upon acceptance of the project, submit documents to the PM Designee, with verification of data accuracy. Mark the Record Drawings with colored pencil. Prepare the Record Drawings as the work progresses. Upon completion of work, submit Record Drawings clearly indicating the following:

1. Locations of devices, conduits, equipment and other pertinent items; Indicate the depth of buried ducts and direct burial cables.

2. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings, and the cable and conduit schedule. The drawings must be detailed to wire and terminal block numbers, conductor color coding, device designations, locations, and reflect identifications established at the site.

1.6 QUALITY CONTROL

1.6.1 General:

The rules, regulations and reference specifications enumerated herein must be considered as minimum requirements. Furnish and install higher grades of material and workmanship when specified herein or when so required by the Contract Drawings. Materials, appliances, and equipment provided must meet the requirements of Nationally Recognized Testing Laboratories (NRTLs) and other standard organizations. This specification must govern when conflicts occur between reference documents and this specification.

1.6.2 Electrical Subcontractor's Qualification:

Use adequate numbers of skilled workers, trained and experienced in their crafts, who are familiar with the specifications and methods of performing the work in this Division.

1.6.3 Licensed:

The electrical foreman must be a licensed master electrician.

1.6.4 Workmanship:

Work must be performed in accordance with quality, commercial practices. The appearance of finished work must be of equal importance with its operation. Material and equipment must be installed based upon the actual dimensions and conditions at the project site. Locations for materials or equipment requiring exact fit must be field measured. Conduit, transformers, and motors must be isolated to avoid unacceptable noise levels from objectionable vibrations from all systems.

1.6.5 Contract Drawings:

Where the electrical drawings indicate (diagrammatically or otherwise) the work intended and the function to be performed even though some minor details are not shown, furnish all equipment, material (other than Government Furnished Equipment), and labor to complete the installation work and accomplish all indicated functions of the electrical installation. Further, take the necessary actions to ensure that all electrical work is coordinated and compatible with all other disciplines, general, NFPA 70 latest edition, and FAA Standards.

1.6.6 View Other Sections:

Review other sections of this specification to determine electrical requirements for equipment furnished under those sections. Coordinate all electrical rough-ins and connections for proper function of this equipment.

1.6.7 Minor Departures:

Minor departures from exact dimensions shown in the electrical plans may

be permitted where required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. Promptly obtain approval from the PM Designee prior to undertaking any such proposed departure.

1.6.8 Listing and Labeling:

Provide products specified in the section that are listed and labeled:

1.6.8.1 Terms "Listed and Labeled:"

The terms "Listed and Labeled" as defined in the National Electrical Code, (latest edition) Article 100.

1.6.8.2 Listing and Labeling Agency Qualifications:

NRTL as defined in OSHA Regulation 29CFR1910.7.

1.6.8.3 Field Installed Nameplates:

Field installed nameplates must conform to Section 26 05 53, IDENTIFICATION OF ELECTRICAL SYSTEMS.

1.6.8.4 Nameplates on Manufactured Items:

Nameplates on manufactured items must be aluminum or type 304 stainless steel not less than 20 US Gauge, riveted, bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of the equipment data.

1.7 DELIVERY, STORAGE, AND HANDLING:

Follow the manufacturer's directions for the delivery, storage, and handling of equipment and materials. Tightly cover equipment and materials and protect from dirt, water, chemical or mechanical injury and theft. Damaged equipment and material will not be acceptable. Upon installation, protect the materials until work is completed and accepted by the Contractor.

1.8 SEQUENCING AND SCHEDULING

1.8.1 Electrical Equipment Coordination:

Coordinate electrical equipment installation with other building components.

1.8.2 Arrangement:

Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

1.8.3 Supporting Device Coordination:

Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.8.4 Sequencing, Coordination, and Integration:

Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning prior to closing in the building.

1.8.5 Connecting Electrical Service Coordination:

Coordinate connecting electrical service to components furnished under other Sections.

1.8.6 Connecting Electrical Systems Coordination:

Coordinate connecting electrical systems with exterior underground and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

1.8.7 Electrical Identification Installation Coordination:

Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Manufacturer's Recommendation:

While installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendation prior to installation. Installation of the item must not proceed until recommendations are received. Failure to furnish the recommendations must be cause of rejection of the equipment or material.

2.1.2 Equipment and Material Characteristics:

Provide equipment and material of sizes, capacities, power ratings and dimensions as indicated on the Contract Drawings and in drawing schedules.

2.1.3 Structural and Miscellaneous Steel:

All structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations must be hot dipped galvanized unless otherwise specified. This includes underground steel pull box covers and similar electrical items. Galvanizing must average 2.0 ounce per square foot and must conform to ASTM A123.

2.1.4 Equipment and Material Approval:

Approval of materials and equipment will be based on the manufacturer's printed data. The label or listing of an NRTL will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Subcontractor may submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures of an NRTL and that the materials and equipment comply with all Contract requirements. A manufacturer's statement indicating complete compliance with the applicable Federal Specification or Standard of the ASTM International, National Electrical Manufacturers

Association or other Commercial Standards, will be acceptable proof of such compliance.

2.1.5 Conformance:

Materials and equipment must conform to respective publications and any other requirements specified below. Furnish all materials. Materials and equipment, to be acceptable, must comply with all contract requirements. Materials to be furnished under this specification must be of manufacturers regularly engaged in the production of such material and of the manufacturer's latest designs that comply with the specification requirements.

2.2 ELECTRICAL IDENTIFICATION:

Provide electrical identification as specified in Section 26 05 53.

2.3 SUPPORT FOR ELECTRICAL EQUIPMENT:

2.3.1 Channel and Angle Supports, Raceway Supports, Sleeves and Fasteners:

As specified in Section 26 05 29.

2.4 MANUFACTURER'S STANDARD PRODUCTS:

Use colors prescribed by ANSI A13.1 and NFPA 70.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 Compliance:

All materials and equipment must be installed in accordance with the Contract Drawings, and with FAA-C-1217, FAA-STD-019, , FAA JO 6000.204, and FAA JO 6950.22A, latest editions.

3.1.2 Electrical Work Coordination:

Coordinate electrical work with that of other trades so that:

3.1.2.1 Interference between Trades:

Interference between electrical and other specialty trades is to be avoided.

3.1.2.2 Clearances:

Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of electrical equipment.

3.1.2.3 Space for Electrical Materials and Equipment:

All electrical materials and equipment must be kept as close as possible to ceilings, walls and columns to occupy the minimum amount of space.

3.1.2.4 Offsets, Fittings, and Related Items Installation:

Furnish and install all offsets, fittings and similar items necessary to

accomplish the requirements of coordination without additional expense.

3.1.2.5 Equipment Disconnection and Relocation:

Equipment required to be temporarily disconnected and relocated must be carefully removed, stored, leaned, reinstalled, reconnected, and made operational.

3.1.3 Installation Methods:

Where manufacturers recommended installation methods conflict with contract requirements, difference must be resolved by the PM Designee.

3.1.4 Qualified Workers:

The installation must be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulation, the workers must be properly licensed.

3.1.5 Component and Equipment Installation:

Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.

3.1.6 Item Positioning during Installation:

Install items level, plumb, parallel, and/or perpendicular to other building systems and components, except where otherwise indicated.

3.1.7 Service Facilitation:

Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.1.8 Waterproof Integrity of Penetrations:

Maintain the waterproof integrity of conduit penetrations through the roof, exterior walls, and floors.

3.1.9 Obstruction Information from Drawings:

The drawings indicate certain information pertaining to surface and subsurface obstructions that has been taken from available site drawings. Such information is not guaranteed as to accuracy of location or completeness.

3.1.10 Proper Anchoring and Support:

Equipment must be properly anchored and supported to resist shear and overturning moments for UBC Seismic Zone 1A.

3.2 INSTALLATION

3.2.1 Contract Drawings:

Where the Contract Drawings schematically indicate the work, diagrammatically or electrically, ensure that the electrical and communications work is coordinated and compatible with Architectural,

Mechanical and Structural work.

3.2.2 Support and Fastening:

Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Section 26 05 29.

3.2.3 Identification Devices

Install identification devices where required in accordance with the requirements of Section 26 05 53.

3.2.4 Wiring Methods:

3.2.4.1 General

All wiring must consist of insulated copper conductors installed in metallic raceways unless otherwise specified.

3.2.4.2 Conductor Routing:

Panelboards, surge arresters, disconnect switches, etc., must not be used as raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.

3.2.4.3 Conductor Separation:

Power conductors must be routed separately from all other conductor types. Route power conductors and other conductors in separate raceways, or use a metallic divider between the power conductors and any other conductors in the same raceway, in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.

a. Power cables of less than 600 volts may be installed in the same duct.

b. Power cables of less than 600 Volts must not be installed in the same duct with control, telephone, or signal type cables.

3.2.4.4 Neutral Conductor

Shared/common neutrals must not be permitted, i.e., each overcurrent protection device must have its own separate neutral conductor. Neutral conductor sizes must not be less than the respective feeder or phase conductor sizes.

3.2.5 Conduit Openings

All conduit openings through floors must be both airtight and watertight.

3.2.6 Weather Protection

Seal equipment or components exposed to the weather and make watertight and rodent proof. Protect equipment outlet and conduit openings with temporary plugs or caps at all times work is not in progress.

3.3 CUTTING AND PATCHING

Cut, channel, chase, and drill floors, walls, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.4 TESTING

3.4.1 General:

Unless otherwise indicated, furnish all test instruments, materials and labor necessary to perform tests designated in other Sections of this Division.

3.4.2 Calibration:

All tests must be performed in the presence of the PM Designee. All instruments must have been calibrated within a period of two years preceding testing. Calibrations must be traceable to applicable industry recognized standards.

3.4.2.1 Tests

Include:

- a. An interim operating and performance test must be performed for each major equipment item after installation is complete and before the item is placed in service.
- b. After mechanical systems have been completely installed and balanced, test each system for proper operation.
- c. Tests must be conducted in the presence of the PM Designee under design conditions to ensure proper sequence and operation throughout the range of operation.
- d. Make adjustments as required to ensure proper functioning of the systems.
- e. Special tests on individual systems are specified under individual sections.
- f. Provide 5 days written notice to the PM Designee for major tests. Demonstrate, to the PM Designee's satisfaction, proper operation of control devices by simulating actual operating conditions.
- g. Devices tested must include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms.
- h. Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system.
- i. Repair or replace equipment that does not meet test requirements and retest. Notify the PM Designee in writing 5 days prior to conducting tests.

3.4.3 Instructions:

After final tests and adjustments have been completed, fully instruct the PM Designee and other personnel as directed by the PM Designee in details of operation and maintenance of electrical equipment.

3.4.4 Underground Cable Test:

Test in accordance with FAA-C-1391, latest edition. Testing of GFM cable must be performed before and after installation.

3.5 DELIVERY, STORAGE AND HANDLING

3.5.1 Cleaning and Wiping:

Clean and wipe the interior of conduit, pullboxes and panelboards before proceeding with the wiring.

3.5.2 Examining Condition:

Do not install damaged, broken or marred material or products, replace them with new.

3.5.3 Repair of Long-Lead Delivery Items:

On long-lead delivery items which are damaged in shipping or storage, field repair may be authorized instead of replacement. Repair authorization must be in writing.

3.6 FIELD QUALITY CONTROL

3.6.1 Restoration of Finish:

All marred or damaged surfaces, except exposed metal for grounding purposes, must be refinished to leave a smooth, uniform finish at final inspection. Paint to match existing.

3.6.2 Repair of Existing Work:

Where cutting, channeling, or drilling of floors, walls, or other surfaces is necessary for the proper installation, support or anchorage of the conduit, raceways, or other electrical work, it must be carefully done. Repair with equal material by skilled workers, any damage to facilities caused by workers or equipment. Prior PM Designee approval must be obtained for the materials, workers, time of day or night, repair method and for temporary or permanent repair purposes. On completion, repair work must be inspected and accepted by the PM Designee with the concurrence of any other affected parties such as Utility Companies and Airport Authority.

3.6.3 Damage:

Where conduit and wiring to remain are inadvertently damaged or disturbed, cut out and remove portion and all damaged wiring from the source panelboard, disconnect switch or pull box to the load/destination point. Provide new wiring of equal capacity.

-- End of Section --

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

1.1.1 General:

The general electrical requirements in this section are applicable to both Parsons' Furnished Equipment and non-Parsons' furnished equipment. Materials and equipment must comply with requirements of the contract documents. Materials provided must be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If material and equipment requirements conflict, the order of precedence for selection must be as follows:

- 1.1.1.1 Special Contract Provisions.
- 1.1.1.2 The contract specifications.
- 1.1.1.3 Federal Aviation Administration (FAA) specifications and standards.
- 1.1.1.4 Contract drawings.
- 1.1.1.5 Military Specifications.
- 1.1.1.6 Federal Specifications.
- 1.1.1.7 NFPA-70 National Electrical Code.
- 1.1.1.8 IEEE Standards.
- 1.1.1.9 NRTL Standards and NEMA Standards.

1.2 REFERENCES

American National Standards Institute (ANSI)

ANSI A13.1	Scheme for the Identification of Piping Systems
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Federal Aviation Administration (FAA)

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment, latest edition
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FAA-C-1217	Electrical Work, Premises Wiring, latest edition
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FAA-C-1391	Installation, Termination, Splicing, and Transient/Surge Protection of Underground Electrical Distribution System Power Cables, latest edition
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FAA JO 6000.204	Maintenance of National Airspace System
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(NAS) Telecommunication Services

FAA JO 6850.5D

Maintenance of Lighted Navigational Aids

FAA JO 6950.22A

Maintenance of Electrical Power Cables

National Electrical Contractors Association (NECA)

NECA 1

Good Workmanship in Electrical Construction

National Fire Protection Association (NFPA)

NFPA 70

National Electrical Code (NEC), latest edition

1.3 ELECTRICAL CHARACTERISTICS

1.3.1 Electrical Equipment and Systems:

Provide the following electrical equipment and systems as directed in the project drawings:

1.3.1.1 Equipment, wiring devices and electrical connections required for installation of electrical equipment.

1.3.1.2 Raceways and wiring for power and controls, including underground ductbanks.

1.3.1.3 Service entrance equipment.

1.3.1.4 Grounding systems.

1.3.1.5 Concrete equipment bases.

1.3.1.6 Cutting and patching for electrical construction.

1.3.1.7 Lightning protection system.

1.3.1.8 Seismic bracing.

1.3.2 Spacing Requirements:

Electrical equipment sizes indicated on the drawings are generally based on specified manufacturer. Verify that the equipment proposed will fit in the space indicated on the drawings. Coordinate building dimensions with architectural and structural drawings. Equipment furnished and installed under other Sections of this Specification must be coordinated with the requirements of this Section. Maintain space about equipment per the latest edition of NFPA 70 Article 110. Establish the exact location of electrical equipment based on the actual field verified dimensions of equipment furnished.

1.3.3 Departure from Dimensions Shown:

1.3.3.1 Minor Departures:

Minor departures from exact dimensions shown in electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are

met. Promptly obtain written approval from the Resident Engineer prior to undertaking any such departures and provide appropriate documentation of the departure.

1.4 SUBMITTALS

SD-03 Product Data: For each type of product specified.

SD-04 Samples: When the adequacy, quality and safety of a material will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified. Submit samples of color, lettering style, and other graphic representation required for each identification product for the project.

1.5 QUALITY ASSURANCE

1.5.1 Compliance:

Comply with latest editions of NFPA 70, FAA-STD-019, FAA-C-1391, FAA-C-1217, FAA JO 6000.204, FAA JO 6850.5D, and FAA JO 6950.22A. for components and installation. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement must apply.

1.5.2 Listing and Labeling:

Provide products specified in the Section that are listed and labeled. The terms "listed and labeled" as defined in the latest edition of NFPA 70, National Electrical Code, Article 100.

1.5.3 Project Record Documents:

Maintain at the job site a separate set of white prints of the contract documents for the purpose of recording the system and dimension changes of those portions of work in which actual construction is at variance with the contract documents. Record changes for all equipment whether provided by Parsons or otherwise. Upon acceptance of the project, submit documents to the Resident Engineer, with verification of data accuracy. Mark the drawings with colored pencil. Prepare the drawings as the work progresses. Upon completion of work submit drawings clearly indicating the following:

Locations of devices, raceways, equipment and other pertinent items. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings and the cable and raceway schedule. The drawings must be detailed to wire and terminal block numbers, conductor color coding, device designations locations and reflect identifications established at the site.

Cable and raceway schedule for cables and raceways actually installed; include the type, size, origin, destination, and approximate length for each cable and raceway.

1.6 DELIVERY, STORAGE AND HANDLING

All provided equipment must be protected from damage and stored in a dry location from the time of site delivery. Conduct routine inspections of stored equipment to check equipment condition. Follow the Manufacturer s

directions for the delivery, storage, and handling of equipment and materials. Tightly cover equipment and materials and protect from dirt, water, chemical or mechanical injury and theft. Damaged equipment and material will not be acceptable. Upon installation, protect the equipment and materials until work is completed and accepted by the Contractor and the FAA.

1.7 SEQUENCING AND SCHEDULING

1.7.1 Coordination:

Coordinate electrical equipment installation with other building components:

1.7.1.1 Arrangement:

Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.

1.7.1.2 Supporting Devices Coordination:

Coordinate installing of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.7.1.3 Sequencing, Coordination, and Integration:

Sequence, coordinate, and integrate installing of electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning prior to closing in the building.

1.7.1.4 Electrical Service Connection Coordination:

Coordinate connecting the electrical service to components furnished under other Sections.

1.7.1.5 Electrical System Connection Coordination:

Coordinate connecting electrical systems with exterior underground and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

1.7.1.6 Electrical Identification Coordination:

Coordinate installing of electrical identification after completion of finishing where identification is applied to field-finished surfaces.

1.7.2 Interruption of Power:

1.7.2.1 NAS Interruption:

Be advised that the project site is a fully operational NAS facility that supports the airport and/or the NAS. **An un-scheduled power interruption to any of the electrical distribution systems or an interruption of the communication systems is not allowed.** Work requiring a temporary or permanent de-energizing of the electrical service must be scheduled and approved in writing by the Resident Engineer at least 14 calendar days in advance of performance of the work. Work may not commence until written authorization is received from the Resident Engineer.

PART 2 PRODUCTS

2.1 SUPPORTING DEVICES

2.1.1 Supports, Sleeves, and Fasteners:

Channel and angle supports, raceway supports, sleeves and fasteners must be as specified in Section 26 05 29, Hangers and Supports for Electrical Systems.

2.2 CONCRETE EQUIPMENT BASES

Forms and reinforcing materials must be as specified in Section 03 00 00, Concrete.

2.3 ELECTRICAL IDENTIFICATION

Provide electrical identification as specified in Section 26 05 53, Identification for Electrical Systems. Manufacturer's standard products to use colors prescribed by ANSI A13.1 and NFPA 70, latest edition.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 NECA Compliance:

Comply with NECA 1, Good Workmanship in Electrical Construction.

3.1.2 Materials and Equipment:

Materials and equipment must be installed in accordance with the contract drawings. Where manufacturer's recommended installation methods conflict with the contract requirements, difference must be resolved by the Resident Engineer. The installation must be accomplished by skilled workers regularly engaged in this type of work. A licensed Master Electrician must be required for all electrical equipment installation, raceway installation, wiring, and electrical tests. Electrical Apprentices may be used under the direct supervision of a Master Electrician.

3.2 EXCAVATION FOR ELECTRICAL WORK

Excavations must comply with Division 31 civil specification requirements.

3.3 INSTALLATION

3.3.1 Rules, Regulations, and Reference Documents:

The rules, regulations, and reference documents indicated must be considered as minimum requirements. Furnishing and installing higher grades of materials and workmanship than are specified or when required by the contract drawings is permitted. Equipment must be installed in a manner to provide proper working space, access, and space for removal of the equipment to suit intended application.

3.3.2 Contract Drawings:

Where the drawings schematically indicate the work, diagrammatically or

otherwise, furnish and install equipment, material and labor for a complete and proper installation. Ensure that electrical and communications work is coordinated and compatible with Architectural, Mechanical, Structural, and Civil work.

3.3.3 Fastening:

Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.

3.3.4 Concrete Pads:

Install concrete pads and bases according to requirements of Section 03 00 00, Concrete.

3.3.5 Identification Devices:

Install identification devices where required in accordance with the requirements of Section 26 05 53, Identification for Electrical Systems.

3.4 DEMOLITION

3.4.1 Protection of Existing Facilities:

Protect existing electrical equipment and installations when performing new work. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality. Remove demolished material from the project site. Remove, store, clean, re-install, reconnect, and make operational components indicated for relocation.

3.4.2 Accessible Work:

Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

3.4.3 Abandoned Work:

Cut and remove buried raceway and wiring, indicated to be abandoned in place to a point 2 feet below the finished grade of adjacent construction. Cap raceways and patch surface to match existing finish. Wire not removed must have the Resident Engineer's written approval.

3.5 CUTTING AND PATCHING

Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved. Repair disturbed surfaces to match adjacent undisturbed surfaces.

-- End of Section --

International Electrical Testing Association (NETA)

NETA ATS Acceptance Testing Specification for
Electric Power Distribution Equipment and
Systems

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code (NEC), latest
edition

Occupational Safety and Health Administration (OSHA)

29CFR1910.7 Definitions and Requirements for a
Nationally Recognized Testing Laboratory
(NRTL)

UL Solutions (UL)

UL 486A Wire Connectors and Soldering Lugs for Use
with Copper Conductors

UL 486C Splicing Wire Connectors

UL 486E Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors

Insulated Cable Engineers Association (ICEA)

ICEA S-84-608 Telecommunications Cable Filled,
Polyolefin Insulated, Copper Conductor
Technical Requirements

National Electrical Contractors Association (NECA)

NECA 1 Standard for Good Workmanship in
Electrical Construction

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in
accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-03 Product Data:

Submit product data for each product specified.

Specifications: Submit manufacturer's data on electric wire, cables,
conductors, connectors, and connector crimping tools where
specified.

SD-06 Test Reports

Field Test Reports: Submit field test reports indicating and
interpreting test results relative to compliance with the
performance requirements of the testing standard.

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.4 QUALITY CONTROL

1.4.1 NFPA Compliance

Comply with NFPA 70, NEC, latest edition, for components and installation.

1.4.2 Listing and Labeling

Provide products specified in this Section that are listed and labeled.

1.4.2.1 The Terms "Listed and Labeled":

As defined in the NEC, Article 100.

1.4.2.2 Listing and Labeling Agency Qualifications:

An NRTL as defined in OSHA Regulation 29CFR1910.7.

1.4.3 Installer Qualifications

Cable splices must be performed by experienced and qualified cable splicers. The workers must be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

1.5.1 Coordination

Coordinate layout and installation of cable with other installations.

1.5.1.1 Locations and Elevations:

Revise locations and elevations from those indicated as required to suit field conditions in coordination with the PM Designee.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver all wire and cable products to the Project site in accordance with NEMA WC26 and in their original packaging. Conductors with damaged insulation must not be permitted.

1.6.2 Storage

Store wire and cable products in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

1.6.3 Handling

Handle wire and cable products carefully to avoid abrading, puncturing, or tearing wire and cable insulation and sheathing. Ensure that the dielectric resistance integrity of wire/cable is maintained.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured in this Section must be in accordance with FAA-C-1217, FAA-STD-019, FAA JO 6000.204, and FAA JO 6950.22A. Unless otherwise indicated, wiring must consist of 600 volt insulated, single conductor, copper conductor, installed in conduit. Conductor must bear easily readable marking along the entire length, indicating conductor size and insulation type.

2.2 ELECTRIC WIRE AND CABLES

2.2.1 Rating

Provide NRTL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3, "Applications" of this section.

2.2.2 Insulation - Above Grade and Interior Use

THHN/THWN conforming to NEMA WC70. XHHW-2 conforming to NEMA WC70. Insulation for conductors in must be rated at 75 degrees C.

2.2.3 Characteristics

2.2.3.1 Wire, Conduit Sizes, and Ampacities:

All wire, conduit sizes, and ampacities are based on copper conductors, 75 degrees C insulation.

2.2.3.2 Conductivity:

Conductivity must not be less than 98 percent at 20 degrees C (68 degrees F) or resistivity greater than 1.7 microohms per centimeter.

2.2.3.3 Solid Conductors:

Provide solid conductors for 10 AWG and smaller, stranded conductors for larger than 10 AWG.

2.2.3.4 Stranded Conductors:

Stranded conductors smaller than 10 AWG are allowed in applications where vibration and flexing may be encountered.

2.2.3.5 Control Wiring:

All control wiring must be stranded.

2.2.4 Size

2.2.4.1 Minimum Power Conductor Size:

Minimum power conductor size must be 12 AWG.

2.2.4.2 Voltage Drop:

Minimum conductor size must be 10 AWG for 120-volt circuits where circuit

2.2.5 Size

2.2.5.1 Minimum Power Conductor Size:

Minimum power conductor size must be 12 AWG.

2.2.5.2 Voltage Drop:

Minimum conductor size must be 10 AWG for 120-volt circuits where circuit length (one way) exceeds 75 feet from source, and 8 AWG for 120 volt circuits where circuit length (one way) exceeds 150 feet from source.

2.2.5.3 Communication/Control System Wiring:

Communication/control systems wiring size must be in accordance with manufacturer's requirements.

2.2.5.4 Minimum Control Wire Size:

Minimum control wire size must be 14 AWG unless otherwise noted.

2.2.6 Color Code

Conductors smaller than 4 AWG must be factory color coded. Color coding must be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable. If there is no standard color coding at the facility, conductors must be color coded as follows

2.2.6.1 AC Power Wiring

120/208 Volt System

Phase	Color
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White

2.2.6.2 Equipment Grounding Conductor:

Green (for all systems)

2.2.6.3 Control Wiring Includes:

- a. Ungrounded conductor wiring - Violet
- b. Grounded conductor wiring - White

2.2.6.4 Control Cables:

Control Cables must be color coded in accordance with (IAW) NEMA WC70.

2.2.7 Uninsulated Conductors

For uninsulated conductors refer to Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.2.8 Prohibited Wire Products

The use of non-metallic sheathed cable types NM to NMC, armored-bushed cable (BX), and armor-clad cable (AC) is prohibited.

2.2.9 Control Cable

Contractor-furnished control cable must be in accordance with the latest edition of of FAA-C-1391, and with Rural Utilities Service 7 CFR 1755.390 (REA/RUS PE-39 (ICEA S-84-608)). This cable must have a core consisting of 19 gauge size (AWG) solid copper conductors with thermoplastic or thermosetting insulation color-coded per telephone industry standards. The core must be completely filled with an ethylene propylene rubber (ETPR) compound. The outer sheath must have a corrugated copper shield applied longitudinally around core. The outside jacket must be black polyethylene. It must be a standard product of a major cable manufacturer, and must be rated for outdoor, direct-earth burial use.

2.2.10 Coaxial Cables

1/2 inch coaxial cable must be a low-loss foam-dielectric, coaxial cable.

2.3 CONNECTORS AND SPLICES

2.3.1 Connectors

Provide NRTL-listed factory-fabricated wiring connectors of size, ampacity and temperature rating, material, type and class required by NFPA and NEMA standards for application and for services indicated. Select connectors to comply with the project's installation requirements and as specified in Part 3, "Applications."

2.3.1.1 Smaller Conductors:

For conductor sizes #10 AWG and smaller, provide 600V solderless, insulated pressure cable connectors, of the compression or indent type, or wire nut connectors.

2.3.1.2 Larger Conductors:

For cable sizes #8 AWG and larger provide long barrel type compression connectors.

2.3.1.3 Stranded Conductors:

Stranded conductors may be used with wire compression connectors or a pressure washer type lug.

2.3.2 Splices

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

2.3.2.1 Splice Envelopes (for power and control/telephone)

a. Power cables 600 volts and below: Cast or pressure epoxy resin splice envelopes or equal, or taped splice using a pre-stretched or heat-shrinkable tubing covering. Known acceptable source for all direct earth burial cable: Not Used.

b. Control and telephone cables: Re-enterable filled splice envelope.

2.3.2.2 Splice Material

Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

2.3.2.3 Insulating Tape

Provide plastic electrical insulating tape that is flame retardant and cold weather resistant. Tape to be used in areas that are subject to 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, must have a minimum thickness of 8.5 mils, and must consist of an oil-resistant vinyl backing with an oil-resistant acrylic adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

Examine raceways that are to receive wires and cables for compliance with installation tolerances and other conditions. Verify that the duct or conduit is open, continuous, and clear of debris before installing cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

3.2.1 Grounded Conductors

In single-phase systems (120 volt two-wire and 120/240 volt three-wire), one grounded conductor (neutral) must accompany each ungrounded phase conductor (120 volt systems) or ungrounded phase conductor pair (120/240 volt systems) powered from a circuit-interrupting device. In three-phase (Y-connected, 4-wire) systems, one grounded neutral conductor must accompany the three related ungrounded conductors fed from a circuit interrupting device. All neutral conductors must extend from the neutral bus in the power source. Device terminals for connection of more than one conductor must be specifically designed for that purpose.

3.2.2 Bundling

Neatly and securely bundle all conductors #10 AWG and smaller located in branch circuit panelboards. Neatly secure cable in individual circuits for all conductors larger than #10 AWG located in pull boxes. Bundle cable with wire ties.

3.3 INSTALLATION

3.3.1 Conductors and Cables

3.3.1.1 Compliance:

Materials installed in this Section must be in accordance with FAA-C-1217, FAA-C-1391, FAA-STD-019, FAA JO 6000.204, and FAA JO 6950.22A.

3.3.1.2 Wire and Cable Installation:

Install wires and cables as indicated, according to manufacturer's written instructions and the NECA 1 "Standard for Good Workmanship in Electrical Construction." Tag all conductors at their termination in accordance with Section 26 05 53, IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.3.1.3 Pulling Conductors:

Pull conductors into raceway simultaneously when more than one is being installed in the same raceway.

a. Use wire pulling compound or lubricant as required. Compound used must not deteriorate the conductor or insulation, and must be non-flammable.

b. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage the cables or raceway.

3.3.1.4 Protective Cable Installation:

Cable must be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering.

3.3.1.5 Exposed Cable Installation:

Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

3.3.1.6 Cable Sealing:

The ends of cables must be sealed with moisture-seal tape before pulling, and must be left sealed until connections are made.

3.3.2 Conductor Splices

3.3.2.1 Splice Locations:

Splices must be made at outlets, junction boxes, pull boxes, manholes/handholes, or accessible raceways only. Splice 600V conductors in pull boxes only. Splices must be made in manholes/handholes as indicated on the drawings only. All other splices within manholes/handholes must require written approval.

3.3.2.2 Solderless Connectors:

Splices must be made with solderless connectors conforming to FS W-S-610, UL 486A, UL 486C, and UL 486E.

3.3.2.3 Wire Nuts:

Wire nuts may only be used to splice conductors sized #10 AWG and smaller.

3.3.2.4 Compression Connectors:

Compression connectors must be used to splice conductors #8 AWG and larger. Use proper connector crimping tools to provide circumferential pressure connection.

3.3.2.5 Electrical Tape or Heat-Shrink Tubing Insulation:

All splices, including those made with insulated wire nuts, must be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.

3.3.2.6 Ungrounded Conductors:

Splicing of ungrounded conductors in panelboards is not permitted.

3.3.2.7 Mechanical Strength and Insulation Ratings:

Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

3.3.2.8 Splice and Tap Connectors:

Use splice and tap connectors that are compatible with conductor material.

3.3.2.9 Methods and Material:

Splicing methods and material must be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced, and must be approved by the RE prior to installation.

3.3.2.10 Differing Color Insulation of Conductors:

Conductors of different color insulation must never be spliced together.

3.3.2.11 Number of Splices:

Keep conductor splices to a minimum.

3.3.2.12 Avoiding Duct or Conduit:

A splice must not be pulled into a duct or a conduit under any circumstances.

3.3.2.13 Waterproof Taps:

Install waterproof taps in underground structures.

3.3.3 Conductor Identification

For conductors #4 AWG and larger, color code in accordance with this Section and Section 26 05 53, IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.3.3.1 Line, Phase, and Neutral Conductors:

All line, phase, and neutral conductors must have their source and circuit labeled.

3.3.3.2 Identification Locations:

Conductor identification must be provided at all terminations, in all junction boxes through which these conductors pass, and within each enclosure where a splice, tap, or termination is made.

3.3.3.3 Terminal and Conductor Identification:

Terminal and conductor identification must match at both ends of the run, as on approved shop drawings.

3.3.4 Wiring at Outlets

Install with at least 12 inches of slack conductor at each outlet for connection to equipment. Identify all conductor circuit numbers at terminals and junction points.

3.3.5 Connections at Outlets

Connect outlets and components to wiring and to ground as indicated on shop drawings. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

3.3.6 Large Conductors

Cables/conductors sizes 250 kcmil and greater must be installed with the use of a hydraulic cable bender where installed exposed (e.g. manholes). Cable supports must be required for stress relief.

3.3.7 Grounding

Grounding must be installed in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

3.3.8 Shared Neutrals and Grounds

Separate neutral and ground wires must be provided for each overcurrent protection device. Shared/common neutrals are not allowed. Install a separate neutral wire per phase for all lighting and power outlet circuits.

3.3.9 Termination

Provide compression type termination lugs where mechanical lugs included with equipment do not comply with FAA-C-1217, latest edition.

3.3.10 Phasing

The phasing of the complete electrical installation must be connected and consistently maintained throughout the power distribution system. The phasing must be "A, B, C, from front to back, top to bottom, or left to right, as viewed from the front of the switchboard, switchgear, or

panelboard."

3.3.11 Conductor Supports

Provide conductor supports as required by the NEC and recommended by the cable manufacturer. Where required, route vertical conductor runs in conduit.

3.3.12 Conductors and Slack

Provide all conductors and connectors necessary for a complete installation from the point of service connections to all devices shown on the drawings, in schedules, and in the specifications. Provide ample slack wire for all connections.

3.4 FIELD QUALITY CONTROL

3.4.1 Testing, General

Cables must be tested prior to installation and again upon completion of the installation. Testing must also be performed prior to termination. Tests must be performed in the presence of the PM Designee.

3.4.1.1 Product Capability and Compliance:

Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

3.4.1.2 Inspection and Testing:

Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

3.4.1.3 Wire and Cable Tests:

Test wire and cable for continuity of circuitry, proper phasing, and also for short circuits.

3.4.2 Insulation Resistance Tests

Feeder and Branch Circuit insulation tests must be performed after installation, but before connection to equipment.

3.4.2.1 Testing Free from Short Circuits and Grounds:

Conductors must test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 50 megohms when measured with a 500-volt DC insulation resistance tester. Submit a letter type test report to the PM Designee prior to final inspection of the Work. The report must list the tests performed and results obtained.

3.4.2.2 Test Voltage Application:

Apply the test voltage for at least one minute after motor reading has stabilized.

3.4.2.3 Record of Megger Readings:

Use "FAA megger form" to record megger readings.

3.4.3 Corrections

Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

-- End of Section --

**SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

This Section includes furnishing material, equipment and labor necessary to install a complete grounding system for the protection of life and equipment from lightning and power faults, and for minimizing electromagnetic interface. Grounding requirements specified in this Section may be supplemented by requirements in other Sections of these Specifications. Work must include the following systems:

- 1.1.1 Power System Grounding
- 1.1.2 Electrical and Electronic Equipment Grounding
- 1.1.3 Raceway Grounding and Bonding
- 1.1.4 Multipoint Grounding

1.2 REFERENCES

Applicable only to the extent specified

ASTM International (ASTM)

- | | |
|----------|---|
| ASTM B3 | Soft or Annealed Copper Wire |
| ASTM B8 | Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft |
| ASTM B33 | Tinned Soft or Annealed Copper Wire for Electrical Purposes |

Federal Aviation Administration (FAA)

- | | |
|-------------|--|
| FAA-C-1217 | Electrical Work, Premises Wiring, latest edition |
| FAA-C-1391 | Installation, Termination, Splicing, and Transient/Surge Protection of Underground Electrical Distribution System Power Cables, latest edition |
| FAA-STD-019 | Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment, latest edition |

Institute of Electrical and Electronic Engineers (IEEE)

- | | |
|-----------|---|
| IEEE 80 | IEEE Guide for Safety in AC Substation Grounding |
| IEEE 1100 | Powering and grounding sensitive electronic equipment |

National Fire Protection Association (NFPA)

NFPA 70

National Electrical Code (NEC), latest edition

Occupational Safety and Health Administration (OSHA)

29CFR1910.7

Definitions and Requirements for Nationally Recognized Testing Laboratories (NRTL)

UL Solutions (UL)

UL 486A

Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 467

Grounding and Bonding Equipment

1.3 SUBMITTALS

Parsons approval is required for all submittals.

SD-01 Preconstruction Submittals

Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

SD-03 Product Data

Grounding Rods

Connectors

Connection Materials

Grounding Fittings

Fall of Potential Test Equipment

Surge and Transient Protection Requirements

Grounding Electrode Conductor

Access Wells

Equipment Grounding Conductors

Underground Conductors

Raceway Bonding Jumpers

Guard Cable

EES (Counterpoise) Cable

SD-06 Test Reports

Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

SD-07 Certificates

Certification of Calibration of Test Equipment

Certified Chemical Analysis

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.4 QUALITY CONTROL

1.4.1 Testing Agency Qualification Data:

An NRTL as defined in OSHA Regulation 29CFR1910.7, or a full member company of NETA.

1.4.1.1 Testing Agency Field Supervision:

Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) to supervise on-site testing specified in Part 3.

1.4.2 Compliance with FAA:

Comply with FAA specifications FAA-C-1217, FAA-C-1391, and FAA-STD-019, latest editions.

1.4.3 Compliance with NFPA:

Comply with NFPA 70, National Electrical Code, latest edition.

1.4.4 Compliance with UL:

Comply with UL 467.

1.4.5 Listing and Labeling:

Provide products specified in this Section that are listed and labeled.

1.4.5.1 The Terms "Listed" and "Labeled":

As defined in the National Electrical Code, Article 100.

1.4.5.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

All types indicated and all sizes and ratings to comply with FAA specifications FAA-C-1217, FAA-C-1391, and FAA-STD-019, latest editions.

Where types, sizes, ratings and quantities indicated are in excess of requirements above, the more stringent requirements and the greater size, rating, and quantity indications must govern.

2.2 EARTH ELECTRODE SYSTEM (EES) (COUNTERPOISE)

2.2.1 Grounding Electrode Conductor:

The grounding electrode conductor must be insulated green copper and must be sized and indicated as shown on the contract documents.

2.2.2 Grounding Rods:

Ground rods must be 3/4-inch diameter by 10 feet copper or copper-clad steel. Sectionalized type or exothermic butt-welded rods must be provided when deeper earth penetration is required. Ground rods must bear the manufacturer's name, trademark and catalog number.

2.2.3 Access Wells:

Access wells must be pre-cast concrete and have a removable cover. The access well must have a minimum interior measurement of 24 inches circular clearance and be of sufficient size to allow ground rod connections to be readily accessible for testing and maintenance. All connections must be made by the exothermic weld process.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

2.3.1 Conformance to NEC:

Conform to NEC Table 8 "Conductor Properties," except as otherwise indicated on Contract Drawings.

2.3.1.1 Material:

Use only copper wire for both insulated and bare for grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials. Conductors must conform to the following:

2.3.1.2 Solid Conductors:

ASTM B3

2.3.1.3 Assembly of Stranded Conductors:

ASTM B8

2.3.1.4 Tinned Conductors:

ASTM B33

2.3.1.5 Size:

Bare ground conductors must be sized in accordance with latest edition of NEC and FAA-STD-019. Minimum allowable size of ground conductors in contact with earth must be not less than 2 AWG.

2.3.2 Equipment Grounding Conductors:

2.3.2.1 Copper conductor with green color insulation.

2.3.2.2 Size:

Equipment grounding conductors must be sized per Table 250.122 of the NEC, latest edition.

2.3.3 Underground Conductors:

Bare, tinned, stranded, except as otherwise indicated.

2.3.4 Grounding Electrode Conductor (GEC)

2.3.4.1 Copper conductor with green insulation

2.4 MISCELLANEOUS CONDUCTORS

2.4.1 Raceway Bonding Jumpers:

Copper, minimum size 6 AWG above grade, 2 AWG below grade.

2.4.2 Guard Cable:

1/0 AWG, 7 strand, bare copper cable.

2.4.3 EES (Counterpoise) Cable:

Minimum 4/0 AWG, 7 strand, bare copper cable.

2.5 CONNECTOR PRODUCTS

2.5.1 Exothermically Welded Connections:

Provide in kit form and select per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items. All underground conductor-to-conductor connections and conductor to ground rod connections must be made by the exothermic weld process, unless otherwise noted. For certain materials and shapes which exothermic welds may not be possible, coordinate connection method with the PM Designee.

2.5.1.1 Exothermic Connections:

Provide exothermic connections.

Submit a Certified Chemical Analysis by an independent test laboratory certifying:

a. The material used contains no phosphorous, caustic, toxic or explosive substance.

b. Weld material used for ground connections contains copper oxide, aluminum and not less than 3 percent tin as a wetting agent. Weld metal for cathodic connections must contain vanadium, but no tin.

c. A minimum of 80 percent of the weld metal must screen out

between 30 and 140 Mesh.

d. Exothermic weld must meet the applicable requirements of IEEE 80, Chapter 9, Section of Conductors and Joints.

e. Molds must be made from graphite or other material withstanding welding temperatures and must be designed to provide average life of not less than 50 exothermic welds under normal conditions. The molds must bear permanent marking, indicating the name of the manufacturer, the mold model, the type, and size of the welding mixture compatible with the welding process and the size of the conductor. Instructions detailing general safety information, welding procedures must be provided with each mold. The installer is prohibited from using a mold from one manufacturer with a different manufacturer's welding mixture.

2.5.1.2 Application:

Exothermic connections to be used outdoors must be suitable for exposure to the elements and direct burial without degradation over the grounding system.

PART 3 EXECUTION

3.1 APPLICATION

3.1.1 Grounding, General:

Installation of FAA grounding requirements often exceed those of NEC; therefore, grounding system must be installed as indicated in Contract Drawings, and as specified herein. Reference IEEE 1100, latest edition, "Recommended Practice for Powering and Grounding Sensitive Electronic Equipment", when installing equipment. In no case must the NEC be violated.

3.1.2 Equipment Grounding Conductor:

Under no circumstances must the equipment grounding conductor be omitted from the electrical system, nor must any separate grounding system such as electrical signal ground or direct connections to the Earth Electrode System be used for an alternate grounding system or an alternate path to the grounding electrode conductor.

3.1.3 Connections:

All ground connections to equipment must be made with a ground connector specifically intended for that purpose.

3.1.4 Separately Derived Systems:

Where NEC requires grounding, ground according to FAA-STD-019.

3.1.5 Main Bonding Jumper:

Equipment grounding conductor must be connected to the grounded conductor (neutral) only at the service disconnecting means and at separately derived systems. This connection is sometimes called the "Main Bonding Jumper."

3.2 INSTALLATION:

3.2.1 Grounding Systems:

Install grounding systems in accordance with latest edition of:

3.2.1.1 FAA-C-1217

3.2.1.2 FAA-C-1391

3.2.1.3 FAA-STD-019

3.2.1.4 NFPA 70

3.2.1.5 Local codes

3.2.2 Service Entrance Grounding:

At the service entrance equipment, bond the service neutral, building neutral and building ground conductor to a common ground bus (or lug). Connect the ground bus (or lug) to the counterpoise grounding system with the grounding electrode conductor. All connections at the service entrance must be made on ground buses (or lugs). Split bolts or cable clamps are not allowed for this connection.

3.2.3 Grounding Electrode Conductor:

This conductor must be connected to the neutral bus in the service disconnecting means and must extend directly to a ground rod in the grounding electrode system in one continuous unspliced run. The grounding electrode conductor must be insulated with green insulation and sized as shown in the Contract Drawings. When not indicated in the contract documents, the conductor must be sized in accordance with NEC Table 250-66 "Grounding Electrode Conductor for AC Systems," except that the conductor must not be smaller than 2 AWG per FAA-STD-019. All grounding electrode conductors, except for those at the outdoor utility transformers, must be routed in PVC raceway. Where the grounding electrode conductor is routed through a metal raceway, the raceway must be electrically continuous and bonded to the conductor at each end with a solid copper conductor welded to the raceway. The grounding electrode conductor must be connected to the Earth Electrode System (EES) by exothermic means. Make connections readily accessible for inspection. For a separately derived system such as an isolation transformer, the grounding electrode conductor must be connected in accordance with the NEC.

3.2.4 Grounded Conductor (Neutral):

Shared/common neutrals (grounded conductor) must not be permitted, i.e., each branch circuit must have its separate grounded conductor. Grounded conductors must be sized in accordance with NEC Article 250.

3.2.5 Earth Electrode System (Counterpoise):

Unless otherwise indicated on Contract Drawings, the grounding electrode system must consist of a minimum of four (4) ground rods located at each corner of the structure.

3.2.5.1 Ground Rods:

Ground rods must be interconnected by a buried, bare, #4/0 AWG, 7 stranded copper cable. The ground cable must be directly buried at least 2'-6" below grade level. The interconnecting cable must close on itself, forming a complete loop, with the ends exothermically welded. Provide sufficient mechanical protection during installation so as not to break cable or connections.

3.2.5.2 Connection to Building Structural Steel:

Connect structural steel of buildings to the earth electrode system with a bare, #4/0 AWG cable.

3.2.5.3 Underground Metal:

All underground metallic pipes, metallic raceway, tanks, and telephone ground must be connected to the earth electrode system by a copper cable no smaller than #2 AWG. Exothermic welds must not be used where hazards exist, i.e. near fuel tanks. In these cases, pressure connectors will be allowed as approved by PM Designee.

3.2.5.4 Exposed Non-Current-Carrying Metallic Parts:

All exposed non-current carrying metallic parts of electrical and mechanical equipment including metallic raceway systems, piping, steel columns and structural members and neutral conductors of the wiring systems must be grounded as required by the latest edition of NEC and FAA-STD-019.

3.2.5.5 Ground Cables:

Install ground cables in Schedule 40 PVC raceway where routed above grade, unless otherwise indicated on Contract Drawings.

3.2.5.6 Guard Wire:

Install guard wire in trench lines where protecting PVC or direct buried cables. Locate guard wire 10 inches (minimum) above the raceway/cable. Connect guard wire to ground rods and the earth electrode system by exothermic means. Space ground rods at approximately 90-foot intervals along the trench line. Locate ground rods 2 feet outside of trench/handhole wall.

3.2.5.7 Pad-Mounted Equipment:

Ground pad-mounted equipment and non-current-carrying metal items by connecting them to Earth Electrode System by exothermic means.

3.2.5.8 Ground Rods:

Install ground rods as follows:

a. Spacing: Ground rods must be as widely spaced as practical and must not be spaced less than one rod length apart. Spacing between rods around structures should be between 10 to 30 feet, nominal 20 feet, as shown on Contract Drawings.

b. Depth of rods: Tops of vertically driven ground rods must be

not less than 12 inches below frost line.

c. Location: Ground rods must be located 2 to 6 feet outside the foundation or exterior footing of the structure.

d. Manholes and Handholes: Install a copper ground bus in each handhole/manhole. Install driven ground rods 2 feet from outside wall of handhole/manhole. Install a 2 AWG bare conductor from ground bus inside the manhole/handhole through a waterproof sleeve in manhole/handhole wall, and exothermically weld to the ground rod.

e. Access Wells: Install where indicated on contract drawings. Set top of well flush with finished grade or floor. Place gravel in well to a level 3 inches below ground rod connections.

3.2.6 Equipment Grounding Conductors:

All metallic non-current carrying parts of electrical equipment must be grounded with equipment grounding conductors whether or not shown on the drawings.

3.2.6.1 Size:

Provide equipment grounding conductors in accordance with Table 250-122 of the NEC, "Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment." Where ungrounded conductors are increased in size to compensate for voltage drop, the equipment grounding conductors must be increased in size proportionately per the NEC. Minimum size must be 12 AWG.

3.2.6.2 Equipment Ground Conductor Installation:

Install equipment ground conductors in the same raceway as its related feeder and branch circuit conductors. Connect this conductor to the ground bus in the panelboard.

3.2.6.3 No Sharing:

Sharing of equipment ground conductors between circuits is not permitted. Each overcurrent protection device must have its own separate equipment grounding conductor.

3.2.6.4 Metal Raceway:

Metal raceway housing the equipment ground conductors must be electrically continuous forming a parallel path to the equipment ground conductor.

3.2.6.5 Grounding Connections:

All connections to equipment to be grounded must be made with a grounding connector specifically intended for that purpose.

3.2.6.6 No Bare Wire Ground Connections:

Bare wire wrapped around connecting screws or mounting bolts and screws, is not acceptable as a ground connection. All ground lugs must be of a non-corrosive material suitable for use as a ground connection and must be compatible with the type of metal being grounded. Ground lugs must be

mounted on clean, bare metal surfaces that are free of paint, rust, etc.

3.2.6.7 No Raceway or Cable Shields as Substitutes:

Raceway or cable shields must not be used as the equipment ground conductor.

3.2.7 Raceway:

All metal raceways must be grounded as follows:

3.2.7.1 Joints:

All joints between raceway sections and between raceway, fittings and boxes must be electrically continuous. All pipe and lockout threads must be treated with a conductive lubricant prior to assembly. Joints that are not otherwise electrically continuous must be bonded with short jumpers of 12 AWG or larger copper wire. The jumpers must be welded or brazed in place or must be attached with clamps, split bolts, grounding bushings or other devices approved for the purpose. All bonds must be protected against corrosion. Cover plates of raceway fittings, pull boxes, junction boxes and other outlet boxes must be grounded by securely tightening all available screws.

3.2.7.2 Components:

Every component of metallic raceway runs such as individual sections, couplings, line fittings, pull boxes, junction boxes and outlet boxes must be bonded, either directly or indirectly, to the ground system or facility steel. Raceway brackets and hangers must be securely bonded to the raceway and to the metal structure to which they are attached.

3.2.8 Equipment Enclosure Grounding:

Ground all enclosures (panels, boxes, cabinets, etc.) of electrical and electronic wiring distribution equipment with approved ground lugs in accordance with the NEC.

3.2.9 Sleeves:

Where ground cables pass through slabs, buildings etc., and when not in metallic enclosures, provide a PVC raceway sleeve.

3.2.10 Electronic Multipoint Ground System:

Comply with the requirements specified in the Contract Drawings and FAA-STD-019, latest edition. Where cables are concealed and not color-coded, any exposed portion of the cable and each end of the cable for a minimum of 2 feet must be color coded as required by FAA-STD-019. Where routed through raceways or wireways, the color-coding must be such that by removing or opening any cover, color-coding must be visible.

3.2.11 Fault Protection:

Prevent equipment parts subject to human contact during installation from being electrically energized during powering faults or when components fail. Ground parts with a low impedance path to the chassis or cabinets in which they are mounted.

3.3 CONNECTIONS:

3.3.1 Materials:

Materials procured and installed in this Section must be in accordance with FAA-C-1217, FAA-C-1391, and FAA-STD-019.

3.3.2 Minimizing Electrolysis:

Make connections so that the possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors and connection methods so metals in direct contact will be galvanically compatible.

3.3.2.1 Electroplating or Hot-Tin-Coating:

Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.

3.3.2.2 Clean Connections:

Make connections with clean, bare metal at points of contact.

3.3.2.3 Dissimilar Metals:

Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.3.2.4 Bronze Pipe Connections:

Where exothermic welding cannot be used or is inappropriate, use FAA approved "U" type bronze pipe connections.

3.3.3 Exothermically Welded Connections:

Used for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

3.3.4 Ground Lugs and Bushings:

Terminate insulated equipment grounding conductors for feeders with pressure-type grounding lugs. Where metallic raceways terminate at non-metallic or non-conductive housings, terminate each raceway with a grounding bushing. Connect grounding bushings with a bare ground conductor to the grounding bus in the housing. Bond electrically non-continuous raceways at both entrances and exits with grounding bushings and bare ground conductors.

3.3.5 Other Grounding Systems:

Any additional ground systems used for electronic equipment must be connected directly to the exterior earth electrode system. The conductor used for other ground systems must be color coded as follows:

3.3.5.1 Multipoint Signal Ground:

Comply with the requirements specified in the Contract Drawings and

FAA-STD-019, latest edition.

3.3.6 Connections at Access Wells:

Use exothermic welded connections between conductors and grounding rods in access wells unless otherwise indicated on Contract Drawings.

3.3.7 Torque:

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with torque tightening values specified in UL 486A.

3.3.8 Compression-Type Connections:

Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Mechanical connections using connectors with equipment when operated at a force of 24,000 pounds are acceptable as FAA approved pressure connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on ground conductor. NRTL listed irreversible compression type bonding connections are permitted for use in lightning protection systems.

3.3.9 Lug Type Connections to Equipment:

Use NEMA 2-hole long barrel ground lugs with three (3) crimps. Ground lugs, connectors and other components must comply with the NEC, latest edition.

3.4 BONDING REQUIREMENTS

3.4.1 Method:

At each location where raceways first penetrate a shelter or building's exterior wall direct connections must be made to the equipment ground.

3.4.2 Location:

Bonding straps include jumpers, must be installed in the following locations:

3.4.2.1 Attachment:

Bonding straps must be attached to the basic member.

3.4.2.2 No Electrical Effect from Motion or Vibration:

Bonding straps must be installed to be unaffected electrically by motion or vibration.

3.4.2.3 Maintenance Accessibility:

Bonding straps must be installed whenever possible in areas accessible for maintenance.

3.4.2.4 No Weakening of Members:

The method of installation and point of attachment of bonding straps must not weaken the members to which they are connected.

3.4.3 Bonding Straps:

Bonding straps must not be compression-fastened through non-metallic material.

3.5 FIELD QUALITY CONTROL

3.5.1 Tests:

Perform tests described below. Ensure no connection to utility power is made during testing.

3.5.1.1 Fall of Potential:

Subject the completed EES system to an earth resistance test using an appropriately calibrated ground test null balance megger instrument designed for the purpose utilizing the fall of potential method (3-point). Measure ground resistance not less than 3 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

3.5.1.2 Earth Electrode System Resistance:

The resistance of the earth electrode system must not exceed 10 Ohms unless otherwise noted.

3.5.1.3 Bolting Resistance:

Spot test to verify that ground cable bolted connections have a DC resistance of one milliohm maximum, when measured with a bridge type milliohmeter or similar instrument.

3.5.1.4 Continuity:

Test ground conductors, sheet metal, metallic raceways, cellular metal deck, equipment enclosure, metallic enclosures, and lighting fixtures for continuity to ground system with a megger.

3.5.1.5 Bonding Resistance:

Unless otherwise specified all bonds must exhibit a resistance of one milliohm or less when measured between bonded members with a 4-terminal milliohm meter.

3.5.1.6 Witness:

Tests must be witnessed by RE and Local FAA.

3.5.2 Deficiencies:

Where ground resistances exceed specified values, tighten connections, modify the EES system by the addition of additional ground rods, or replace faulty wiring as required until continuity/resistance conforms to the NEC requirements and the requirements of this Specification. Re-measure the continuity/resistance to verify compliance.

3.5.3 Report:

Prepare field tests and observation reports, certified by the testing organization, of continuity/resistance at each test location. Include observations of weather and other phenomena that may affect test results. Submit test reports to RE.

3.6 EARTH ELECTRODE SYSTEM RESISTANCE TEST PROCEDURE

A qualified electrician must perform the test. The procedure is the fall of potential method (three terminal test).

3.6.1 Sketch:

Prepare a sketch utilizing contract shelter grounding plan drawings of the EES. Select a point on the EES and a direction of measurement which is away from the EES under test, and away from known underground metallic objects (water pipes, cables, etc.).

3.6.2 Connection to EES:

Connect the jumpered C1-P1 lead to the EES at point E.

3.6.3 Position of current probe C2:

From the Selected electrode or point E and in the chosen direction, position the current probe (C2) at a convenient distance (D) or (X) from the measurement point. Refer to Test Method "A" (REIL, PAPI and ASR). Refer to Test Method B (ILS, ALSF, VOR, and MALSR). (NOTE: Readings obtained for the facility ground resistance are more accurate when the spacing between E and probe C2 is maximized. The distance chosen may be limited to the area available. Vary probe spacing to avoid paved areas.)

3.6.4 Position of Potential Probe P2:

Refer to Test Method "A" for REIL, PAPI and ASR. Refer to Test Method "B" for ILS, ALSF, VOR, and MALSR.

3.6.5 Measurements:

Drive Probes 4" to 12" Deep into Earth at several points on a straight line between the measurement point (E) and Probe (C2). Measure the resistance in accordance with the instrument manufacturer's instructions. When performing these measurements the resistance read should increase to a certain point, level off, and increase again. A plot of Resistance to Earth vs. Distance may be drawn by using the values obtained as the P2 probe is moved toward or away from the C2 probe. The correct resistance to earth at the electrode being measured at point (E) is estimated by extrapolating the curve to its asymptotic value (where curve levels off). This test is repeated to verify correct readings. If the curve does not level off, the current probe (C2) must be placed at an increased distance from the measurement point (E).

3.6.5.1 Repetition:

Repeat the above measurements in other directions at least 60 degrees from the first line of measurement and from other earth electrodes of the earth electrode system being checked. Whenever the test probe locations are moved to other areas, there may be a difference in soil conditions which

will result in a change to the resistance values at each probe position and/or the derived plot obtained.

3.6.6 Test Method "A"

3.6.6.1 Determination:

Determine the maximum dimension X of the EES system. For a circle, this dimension is the diameter; for a square or rectangle, the dimension is the diagonal; for other shapes, select the longest lateral distance across the EES system. Locate the current probe C2 of the earth tester at a distance equal to or greater than 5 times the dimension X. Earth testers are typically supplied with approx. 100' probe leads. For all but the simplest EES System, 100' leads are insufficient for spacing of probe C2 and potential probe P2. The 100' spacing may be used for one or two-rod systems where the rods are not more than 20' apart. Thus, in most cases, additional lead wire must be needed for connecting the test instrument to Probes C2 and P2. For distances up to 1000', number 16 AWG wire may be used. Standard lamp cord is an acceptable lead.

3.6.6.2 Positioning C2 Probe:

Position the C2 Probe along a line which maximizes the distance from the electrode under test & from other buried metals such as utility pipes, power & signal cables, fuel tanks, etc. In choosing the direction for the placement of C2 probe, examine the configuration of the electrode system for the facility & determine the location of all such buried metal facilities. Then locate the probe as far as possible from all these metal facilities.

3.6.6.3 Positioning P2 Probe:

Next position the Probe P2 along a straight line between probe C2 and the point of connection to the EES System under test. Record the first P2 resistance reading. Following the instructions supplied with the tester, with probe P2 located about 10 percent of the distance X between the EES and Probe C2, take the second reading. Repeat the measurement at 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, & 0.9 of distance X. Record the distance and the resistance measured at each P2 location on the data sheet.

3.6.7 Test Method "B" (Perform for ALSF, MALSR, VOR and ILS Facilities Only)

3.6.7.1 Positioning C2 Probe:

Position the C2 probe along a line which maximizes the distance from the EES under test and from other buried metals such as utility pipes, power and signal cables, fuel tanks, etc. In choosing the direction for placement of the C2 probe, examine the configuration of the electrode system for the facility and determine the location of all such buried metal systems. Then locate the probe as far as possible from these metals. Keep C2 and P2 leads separated as far as possible.

3.6.7.2 Positioning C2 and P2 Probes:

Position the C2 and P2 probe at distances coordinated in the field with the PM designee. Record the resistance readings at each probe position. (Note that the P2 positions are 62 percent of the C2 positions). It may not be necessary to plot the full 500 feet. Plot enough points to

accurately determine where the curve levels off.

3.6.7.3 Graph of Resistance Readings Vs. Probe Positions:

Plot on a graph as many recorded resistance readings versus the corresponding probe positions as necessary to determine where the curve levels off.

3.6.7.4 Estimating True Value of Resistance:

The true value of resistance can be estimated by extrapolating the curve to its asymptotic value (where curve levels off).

3.7 ADJUSTING AND CLEANING

Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying and other activities to their original condition in accordance with other sections of this specification. Maintain restored surfaces.

-- End of Section --

**SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.1.2 Types:

Types of supports, anchors, sleeves, seals and fastenings specified in this Section include the following:

- 1.1.2.1 Clevis hangers
- 1.1.2.2 C-Clamps
- 1.1.2.3 Toggle bolts
- 1.1.2.4 One-hole conduit straps
- 1.1.2.5 Two-hole conduit straps
- 1.1.2.6 Wall and floor seals

1.2 REFERENCES

Applicable only to the extent specified.

Federal Aviation Administration (FAA)

- | | |
|-----------------|--|
| FAA-C-1217 | Electrical Work, Premises Wiring (latest edition) |
| FAA-STD-019 | Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment (latest edition) |
| FAA JO 6000.204 | Maintenance of National Airspace System (NAS) Telecommunication Services |
| FAA JO 6950.22A | Maintenance of Electrical Power Cables |

National Fire Protection Association (NFPA)

- | | |
|---------|--|
| NFPA 70 | National Electrical Code (NEC), latest edition |
|---------|--|

ASTM International (ASTM)

- | | |
|------------|--|
| ASTM A1011 | Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength |
|------------|--|

Low-Alloy with Improved Formability

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Product data for each type of product specified.

Clevis Hangers

C-Clamps

Toggle Bolts

One-Hole Conduit Straps

Two-Hole Conduit Straps

Wall And Floor Seals

Retainers

Ceiling Trapeze Hangers

Wall Brackets

Spring Steel Clamps

Riser Clamps

Fasteners

Expansion Anchors

Power-Driven Threaded Studs

U-Channel

Conduit Sealing Bushings

Conduit Sleeves And Seals

Continuous Slotted Channels

Steel Brackets

Pipe Sleeves

1.4 QUALITY CONTROL

1.4.1 Electrical Component Standard:

Components and installation must comply with NFPA 70, (NEC) latest edition. Electrical components must be listed and labeled by a nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured and installed in this Section must be in accordance with FAA-C-1217, FAA-STD-019, FAA JO 6000.204, and FAA JO 6950.22A, latest editions, for components and installation. In case of conflict between provisions, the most stringent apply.

2.2 COATINGS

Supports, support hardware, and fasteners must be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products for use outdoors must be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

2.3.1 Raceway Supports:

Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps comply with NEC, latest edition and the following requirements:

2.3.1.1 Conformance:

Conform to manufacturer's recommendation for selection of supports.

2.3.1.2 Support Strength:

Strength of each support must be adequate to carry the design load plus 25 percent for future use, multiplied by a safety factor of at least of four. Where this determination results in a safety of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.

2.3.2 Fasteners:

Types, materials, and construction features as follows:

2.3.2.1 Expansion Anchors:

1/2 inch lead expansion anchors approximately 38 pounds per 100 units.

2.3.2.2 Toggle Bolts:

3/16 inch by 4 inch spring head toggle bolts approximately 5 pound per 100 units.

2.3.2.3 Pneumatic or Battery Power-Driven Threaded Studs:

Heat-treated steel, designed specifically for the intended service.

2.3.3 Channel Systems (U-Channel):

Conform with ASTM A1011 SS GR 33. 16-gauge channels, stainless steel type 304 for outdoor locations, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that

mate and match with U-channel and are of the same manufacturer.

2.3.4 Conduit Sealing Bushings:

Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in conduits subject to exposure to water and/or oil penetration at conduit joints. Provide plugs with number and size of conductor gripping holes as required to suit installation. Construct body of malleable iron casting with hot-dipped galvanized finish.

2.3.5 Conduit Sleeves and Seals:

Provide conduit sleeves and seals of types, sizes and materials indicated with the following features:

2.3.5.1 Factory-Assembled Watertight Wall and Floor Seals:

Provide factory-assembled watertight wall and floor seals of types and sizes suitable for sealing conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.

2.3.6 Continuous Slotted Channels:

Dimensions as required for loads imposed.

2.3.7 Clamps:

Sized for application.

2.4 FABRICATED SUPPORTING DEVICES

2.4.1 General:

Shop or field fabricated supports or manufactured supports assembled from U-channel components.

2.4.2 Steel Brackets:

Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

2.4.3 Pipe Sleeves:

Provide pipe sleeves for steel pipe to be fabricated from Schedule 40 galvanized steel pipe.

2.4.4 Seismic Requirements:

Supporting devices must meet seismic requirements of Zone 1A.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Supporting Devices:

Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

3.1.2 Coordination:

Coordinate with the building structural system and with other electrical installation.

3.1.3 Raceway Supports:

Comply with the NEC and the following requirements:

3.1.3.1 Conformance:

Conform to manufacturer's recommendations for installation of supports.

3.1.3.2 Spacing:

Space supports for raceways in accordance with the NEC.

3.1.3.3 Exposed and Concealed Raceway Support:

Support exposed and concealed raceway within 3 feet of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

3.1.3.4 Vertical Runs:

In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

3.1.4 Miscellaneous Supports:

Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

3.1.5 Cable Supports:

3.1.5.1 Compliance:

Install in strict compliance with manufacturer's instructions.

3.1.5.2 Spacing:

Spacing not to exceed NFPA 70, latest edition, tabulation for spacing of conductor supports.

3.1.5.3 Slack:

Allow adequate slack in conductors to prevent any stress on terminations. Take into consideration conductor thermal contraction.

3.1.5.4 Cable Training:

Train cables for a neat and orderly installation.

3.1.6 Sleeves:

Install in concrete slabs and walls for raceways and cable installations. Tighten sleeve seal nuts until sealing grommets have expanded to form a watertight seal.

3.1.7 Fastening:

Unless otherwise indicated, fasten electrical items (including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, lighting fixtures and control components) and their supporting hardware securely to the building structure in accordance with the following:

3.1.7.1 Toggle Bolts:

Toggle bolts on hollow masonry units;

3.1.7.2 Concrete Inserts or Expansion Bolts:

Concrete inserts or expansion bolts on concrete or solid masonry;

3.1.7.3 Screws, Studs, or Clamps:

Machine screws, welded threaded studs, or spring tension clamps on steel.

3.1.7.4 Sheet Metal Screws:

Sheet metal screws in partitions of light steel construction.

3.1.7.5 Threaded Studs:

Threaded studs, driven by a powder charge and provided with lock washers and nuts, may be used instead of expansion bolts and machine or wood screws with express written consent and approval from the FAA and other Authorities Having Jurisdiction (AHJs) to use explosive material such as a powder charge on the premises..

3.1.7.6 No Welding to Steel Structures:

Do not weld conduit (with the exception of exothermic welds for grounding), pipe straps, or items other than threaded studs to steel structures.

3.1.7.7 Holes:

Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete must not cut the main reinforcing bars. Fill holes that are not used.

3.1.7.8 Fastener Protection:

Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

3.1.8 Tests:

3.1.8.1 Pullout Resistance:

Test pullout resistance of one of each type, size, and anchorage material for the following fastener types:

- a. Expansion anchors.
- b. Toggle bolts.
- c. Power-driven threaded studs.

-- End of Section --

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes furnishing material, equipment, labor and incidentals necessary to install a complete and operational system of raceways, fittings, boxes, enclosures, and cabinets for each type of electrical system.

1.1.2 Raceway Types:

Types of raceways in this Division include the following:

1.1.2.1 PVC-RGS:

PVC coated rigid galvanized steel.

1.1.2.2 PVC:

Polyvinyl chloride conduit (PVC).

1.1.2.3 RGS or RSC:

Rigid steel (metal) conduit, zinc coated (RGS or RSC).

1.1.2.4 EMT:

Electrical metallic tubing (EMT).

1.1.2.5 LFMC:

Liquidtight flexible metal conduit.

1.1.2.6 HDPE:

High Density Poly-Ethylene conduit.

1.1.3 Box Types:

Types of boxes, enclosures, and cabinets in this Division include the following:

1.1.3.1 Outlet boxes.

1.1.3.2 Pull and junction boxes.

1.1.3.3 Cabinets and enclosures with hinged covers.

1.1.3.4 Wireways

1.2 REFERENCES

The current issues of the following documents in effect on the date of the

Request-For-Offers from part of this Specification and are applicable to the extent specified herein:

American National Standards Institute (ANSI)

ANSI C80.1 Rigid Steel Conduit, Zinc-Coated RGS.
ANSI C80.3 Electrical Metallic Tubing, Zinc-Coated (EMT).

ASTM International (ASTM)

ASTM E8 Standard Test Methods for Tension Testing of Metallic Materials
ASTM F1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
ASTM F2160 Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

Federal Aviation Administration (FAA)

FAA-STD-019 Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities (latest edition)
FAA JO 6000.204 Maintenance of National Airspace System (NAS) Telecommunication Services
FAA JO 6950.22A Maintenance of Electrical Power Cables
FAA-C-1217 Electrical Work, Premises Wiring (latest edition)

National Electrical Contractors Association (NECA)

NECA 1 Standard for Good Workmanship in Electrical Construction

National Electrical Manufacturers Association (NEMA)

NEMA FB1 Fitting, Cast Metal Boxes, and Conduit Bodies, and Cable Assemblies
NEMA 250 Enclosures for Electrical Equipment (1000 Volts and Below)
NEMA TC7 Solid-Wall Coilable and Straight Electrical Polyethylene Conduit

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code (NEC), latest edition

Occupational Safety and Health Administration (OSHA)

29CFR1910.7 Definitions and Requirements for a
Nationally Recognized Testing Laboratory
(NRTL)

UL Solutions (UL)

UL 6	Rigid Metal Conduit
UL 50	Enclosures for Electrical Equipment
UL 360	Liquid-tight Flexible Metal Conduit
UL 514A	Metallic Outlet Boxes
UL 514B	Conduit, Tubing, and Cable Fittings
UL 797	Electric Metallic Tubing
UL 651	PVC Conduit

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit dimensioned drawings of raceway and wireway systems showing layout of raceway at all congested areas such as above and below panelboards.

SD-03 Product Data

Manufacturer's product data for all conduit and tubing, raceway fittings, outlet boxes, pull and junction boxes, hinged cover enclosures, and cabinets. Include specifications, installation instructions and general recommendations.

1.4 APPLICATIONS:

Boxes must be provided in the wiring and raceway system for pulling wires, making connections.

1.5 QUALITY CONTROL

1.5.1 Compliance with NEC:

Comply with latest edition of the NFPA 70 "National Electrical Code" (NEC) for components and installation.

1.5.1.1 Box Sizing:

Boxes must be sized in accordance with NEC Article 370.

1.5.2 Listing and Labeling:

Provide products specified in this Section that are listed and labeled.

1.5.2.1 The Terms "Listed and Labeled":

As defined in the "National Electrical Code," Article 100.

1.5.2.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

1.5.3 Compliance with NECA:

Comply with NECA 1 "Standard for Good Workmanship in Electrical Construction."

1.5.4 Coordination:

Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 PRODUCTS

2.1 GENERAL:

2.1.1 Conformance:

Enclosures must conform to NEMA standards.

2.1.2 Materials:

All materials procured under this specification must be in accordance with FAA-C-1217, FAA-STD-019, FAA JO 6000.204, and FAA JO 6950.22A, latest editions, for components and installation. In case of conflict between provisions, the most stringent apply.

2.1.3 Raceway Size:

Raceways must be adequately sized to include the phase conductors, an equipment ground conductor (green) and a neutral conductor (gray or white) in accordance with percentage fill requirements by NFPA 70 (NEC) latest edition. Note: Per FAA-STD-019, equipment grounding conductors are sized the same as phase conductors, impacting raceway size.

2.1.3.1 Minimum Conduit Size:

Provide 3/4-inch conduit minimum unless otherwise indicated on Contract Drawings.

2.2 CONDUIT AND TUBING

2.2.1 Rigid Steel Conduit:

Heavy wall mild steel tube with metallic corrosion resistant coating on exterior and interior, hot dipped galvanized steel, free from defects; Manufactured in accordance with ANSI C80.1 and UL 6.

2.2.2 PVC Coated Steel Conduit:

Meeting the requirements of Rigid Steel Conduits; 40mil PVC exterior

coating and urethane interior coating, in accordance with NEMA RN 1.

2.2.3 Electrical Metallic Tubing:

Welded steel tubing, formed of low carbon steel, electro-galvanized exterior, inside coated with a baked, elastic low-friction coating of enamel, in accordance with ANSI C80.3 and UL 797.

2.2.4 Liquidtight Flexible Metal Conduit (LFMC):

Flexible steel conduit with PVC jacket: Liquidtight conduit must have an extruded, polyvinyl jacket over the flexible metal in accordance with UL 360.

2.2.4.1 No FNMC:

Flexible non-metallic conduit (FNMC) must not be used.

2.2.5 Rigid Non-Metallic Conduit (PVC):

Schedule 40 and 80 high impact, polyvinyl chloride, in accordance with UL 514B and UL 651 and with NRTL listing.

2.2.6 High Density Polyethylene Raceway (HDPE):

HDPE raceway must meet the requirements of ASTM F2160, ASTM F1962, and NEMA TC7. Use standard dimension ratio (SDR) 11 HDPE raceway. The SDR of a raceway is defined as the ratio of the average raceway diameter divided by the minimum wall thickness.

2.3 RACEWAY FITTINGS, COUPLINGS AND CONNECTORS

2.3.1 Material:

Use fittings listed and approved for specific conduit or raceway system used.

2.3.2 Bushings and Connectors:

Bushings and connectors must be insulated type which maintain continuity of conduit ground system. Insulating material must be molded or locked into metallic body of the fitting. Bushing made entirely of nonmetallic material will not be allowed.

2.3.3 Fittings and Conduit Bodies:

UL 514B and NEMA FB 1, compatible with conduit and of the threaded type.

2.3.3.1 Rigid Steel Conduit:

Threaded type material to match the conduit, in accordance ANSI/NEMA FB1.

2.3.3.2 Rigid Non-Metallic Conduit:

Solvent-welded, slip-on joints.

2.3.3.3 Below Grade Installations:

For installation below slab, on-grade, or underground, the conduit must be

factory coated with either 0.008 inch of epoxy, 0.020 inch of polyvinyl chloride or 0.063 inch of coal-tar enamel or must be field wrapped with 0.01-inch-thick pipe wrapping plastic tape applied with 50 percent overlap.

2.3.3.4 Electrical Metallic Tubing:

Fittings used with EMT must be compression-type fittings designed for this type of conduit, unless otherwise indicated. Screw-type fittings are not acceptable. Connectors must have insulated-throat, smooth bell-shaped end or a bushing.

2.3.3.5 No Set Screw Fittings:

Set screw fittings are not allowed.

2.3.4 Elbows and Bends:

Rigid and nonmetallic conduit system must use factory elbows and bends for conduits 2 inches and larger for all bends greater than 45 degrees. Other conduit systems must use the same material as the conduit with which they are installed.

2.3.5 Bushings:

High impact, thermosetting, phenolic insulation, 150 degrees C.

2.3.6 Ground Bushing:

Must consist of a malleable iron, insulated throat conduit bushing with an attached set screw lug.

2.3.7 Locknuts:

Zinc-plated or Cadmium-plated, malleable iron.

2.3.8 Threaded Nipples:

Conduit nipples must have two independent sets of thread.

2.3.9 Hubs:

Cadmium-plated, malleable iron with tapered threads and neoprene "O" ring.

2.3.10 Liquidtight Flexible Metal Conduit (LFMC) Fittings:

Liquidtight flexible metal conduit fittings must be made of galvanized steel. They must be insulated and one of the following types:

2.3.10.1 Wedge and Screw Type:

Wedge and screw type having an angular wedge fitting between the convolutions of the conduit.

2.3.10.2 Squeeze or Clamp Type:

Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.

2.3.10.3 Steel, Multiple Point Type:

Steel, multiple point type, for threading into the internal wall of the conduit convolutions.

2.3.11 No Use of Inferior Material:

Inferior material such as "pot metal" must not be used for any type of fitting.

2.3.12 Locknuts:

All locknuts must be of the bonding type with sharp edges for digging into the metal wall of the enclosure.

2.3.13 Frangible Couplings:

Frangible couplings must break away with applied load not to exceed 75 lbs. The frangible coupling and mounting flanges must be designed for use with 2-inch (51 mm) electrical metallic tubing (EMT) and must be suitable for mounting on a concrete pad. Anti-seizing compound must be applied on the threads of the frangible couplings prior to insertion into the rigid couplings and mounting flanges.

2.4 OUTLET BOXES

2.4.1 Sheet Metal Boxes:

NEMA OS 1 and UL 514A; Galvanized steel with 1/2-inch male fixture studs where required.

2.4.2 Cast Metal Boxes:

NEMA FB 1, type FD, cast alloy box with gasketed cover, threaded hubs. Use cast boxes for damp and outdoor locations.

2.4.3 Fittings:

UL 514B

2.5 PULL AND JUNCTION BOXES:

2.5.1 Small Sheet Metal Boxes:

NEMA OS 1 and UL 514A.

2.5.2 Cast Metal Boxes:

2.5.2.1 Threaded-Hub Type:

Threaded-hub type conforming to UL 514A and UL 514B.

2.5.2.2 Galvanized Steel:

Galvanized steel conforming to UL 514A and UL 514B.

2.5.3 Covers:

Class 30B gray cast iron conforming to ASTM E8, machine finished with flat

bearing surfaces.

2.5.4 Wireways

NEMA 1 indoors, NEMA 4X outdoors, removable or hinged cover.

2.6 INTERIOR/EXTERIOR CABINETS AND ENCLOSURES

2.6.1 Hinged Cover Enclosures:

NEMA 250 interior, NEMA 250 Type 4X exterior, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.

2.6.2 Cabinets and Enclosures:

NEMA 250 interior, NEMA 250 Type 4X exterior, code gauge galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6.2.1 Construction:

Cabinets and enclosures must be constructed with the characteristics listed below and with interior dimensions not less than those:

- a. Indicated on the Contract Drawings.
- b. Provide 5/8-inch plywood backboard unless otherwise indicated.
- c. Key latch to match panelboards. Provide two keys with each cabinet unless otherwise notified.
- d. Interior cabinets and enclosures must be rated NEMA 1, minimum.
- e. Exterior cabinets and enclosures for power equipment must be rated NEMA 4X, minimum.
- f. Exterior cabinets and enclosures for splice/communication/control must be rated NEMA 4X (fiberglass).
- g. Exterior cabinet front covers must have a minimum of one (1) latch or securing device on each of the three non-hinged sides. If the cabinet cover is not hinged it must have a minimum of one (1) latch or securing device on each of the four sides.

2.6.3 Safety:

UL 50

2.6.4 Locks:

All locks in this project must be keyed alike.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Examination:

Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.1.2 Raceway Examination:

Examine raceways prior to installation. No crushed or deformed raceway must be installed.

3.1.3 Electrical Box Locations:

Provide electrical boxes in locations shown on the plans and as required for splices taps, wire pulling equipment connections and code compliance.

3.2 WIRING METHODS

3.2.1 Outdoors:

Use the following wiring methods:

3.2.1.1 Underground Encased Concrete Ductbank:

Rigid galvanized steel conduit and fittings.

3.2.1.2 Exposed:

Rigid steel conduit, unless otherwise indicated on Contract Drawings.

3.2.1.3 Underground, Single or Grouped Run:

Rigid steel/PVC conduit and fittings as indicated on Contract Drawings.

3.2.1.4 Connection to Vibrating Equipment (including transformers):

Liquid-tight flexible metal conduit.

3.2.1.5 Boxes and Enclosures:

NEMA Type 4X, as specified in Part 2.

3.2.2 Indoors:

Use the following wiring methods:

3.2.2.1 Connection to Vibrating Equipment:

Flexible metal conduit, except in wet or damp locations, use liquid-tight flexible metal conduit.

3.2.2.2 Damp or Wet Locations:

Rigid steel conduit.

3.2.2.3 Exposed:

Rigid steel conduit. Rigid steel conduit must be used in the electrical/mechanical rooms to a height of 8 feet above finished floor.

3.2.2.4 Boxes and Enclosures:

NEMA Type 1.

3.2.3 Conduit Use:

3.2.3.1 Feeders:

Install rigid steel conduit (RSC) for all distribution panel feeders, transformer feeders.

3.2.3.2 Underground Ductbanks:

Use rigid steel or PVC conduit and fittings for underground ductbanks as indicated on Contract Drawings.

3.2.3.3 In Earth:

Use PVC coated rigid galvanized steel conduit for all conduit systems installed in contact with earth.

3.2.3.4 Conduit System Ends:

Ends of conduit systems not terminated in boxes or cabinets must be capped.

3.2.3.5 Enclosures without Hubs:

Where conduits enter enclosures without hubs, an appropriate connector with threads and locknuts must be used to securely bond the conduit to the enclosure.

3.2.3.6 Connectors:

The connector body and locknut must be installed so that firm contact is made on each side of the enclosure. In addition, the connector must be the insulated-throat type.

3.2.3.7 Dry Interior Locations:

EMT may be used only in dry interior locations, and where not subject to physical damage.

3.2.3.8 Circuits above 600 Volts:

EMT must not be used on circuits above 600 volts or in sizes greater than 4 inches in diameter.

3.2.3.9 Above Grade:

EMT must be used above grade in conjunction with frangible fittings as indicated on Contract Drawings.

3.3 INSTALLATION:

3.3.1 Compliance:

Products must be installed in accordance with the latest editions of:

3.3.1.1 FAA-C-1217

3.3.1.2 FAA-C-1391

3.3.1.3 FAA-STD-019

3.3.2 Conduit:

3.3.2.1 Minimum Conduit Size:

Minimum size for conduit power circuits must be 3/4 inch, unless otherwise noted.

3.3.2.2 Telephone and Signal Conduit:

Conduit for telephone and signal systems must be as follows:

1. 1/2-inch conduit may be used for lengths not exceeding 50 feet. 3/4-inch conduit may be used for lengths not exceeding 100 feet.

2. 1-inch conduit must be used for lengths exceeding 100 feet.

3.3.2.3 Maximum Number of Bends:

No run must contain more than four (4) 90-degree bends, or the equivalent between boxes. Provide pull and junction boxes required to meet this criterion.

3.3.2.4 Conduit Sizing:

Size conduits as required by the NEC for the number and sizes of wires to be pulled into the conduit.

3.3.2.5 Conduit Bodies:

Use conduit bodies to make sharp changes in directions around ground beams.

3.3.2.6 Temporary Closures/Caps:

Use temporary closures/caps to prevent foreign matter and moisture from entering conduit.

3.3.2.7 Conduit Fittings:

Use conduit fittings suitable for use and location.

3.3.2.8 Conduit Under/Embedded in Slabs:

Install in middle third of the slab thickness where practical and leave at least 1 inch concrete cover.

- a. Secure conduit to reinforcing rods to prevent sagging or

shifting during concrete placement.

b. Space conduit laterally to prevent voids in the concrete.

c. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

3.3.2.9 Below Slab, On-Grade, or Underground Installation:

For installation below slab, on-grade, or underground, the Rigid Steel Conduit must be PVC coated, 0.063 inch of coal-tar enamel or must be field wrapped with 0.01-inch-thick pipe wrapping plastic tape applied with 50 percent overlap. Fittings used underground must be protected by field wrapping as specified herein for conduit.

3.3.2.10 Field Cut Conduit:

Where conduit has to be cut in the field, it must be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit must be reamed to remove burrs and sharp edges.

3.3.2.11 Field Threaded Conduit:

Where threads have to be cut on conduit, the threads must have the same effective length and must have the same thread dimension and taper as specified for factory-cut threads on conduit.

3.3.2.12 Terminations:

Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box.

Where terminations cannot be made secure with one locknut, or where conduits enter enclosures without threaded hubs, use two locknuts, one inside and one outside the box to securely bond the conduit to the enclosure.

a. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

3.3.2.13 Bushings:

Install a bushing on the interior threaded end of each conduit to protect conductor insulation.

3.3.2.14 Bends and Offsets:

Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. Where space conditions prohibit the use of standard elbows, use ferrous alloy fittings to match the conduit construction.

Condulet-type fittings must not be used on conduits containing #4 AWG or larger wire.

a. Bends in conduit that are 1 inch and larger must have minimum inside radii 12 times the nominal conduit diameter.

3.3.2.15 Frangible Couplings:

The point of frangibility must be located no higher than 3-inches above grade when installed.

3.3.3 Raceways:

Complete raceway installation before starting conductor installation. Inside of raceways must be reamed, deburred, fished and swabbed before conductors are pulled.

3.3.4 Support:

Support raceways, boxes, cabinets and enclosures in accordance with Section 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

3.3.5 Floor and Wall Penetrations:

3.3.5.1 Through-Penetrations:

Penetrations through walls or floors separating the building interior from the exterior must be sealed to prevent moisture and rodent entry and to deter air transfer.

3.3.5.2 Penetration Sealing:

Seal penetrations of walls which separate individually temperature- or humidity-controlled areas, to prevent air circulation.

3.3.5.3 Conduit Sealing:

Conduit sealing methods and sealants must be in accordance with the NEC.

3.3.5.4 Conduit Concealing:

Conceal conduit unless otherwise indicated, within finished walls and ceilings.

3.3.6 Exposed Raceways:

Install exposed raceways parallel to or at right angles to nearby surfaces or structural members and follow the surface contours as much as practical.

3.3.6.1 Parallel or Banked Raceways:

Run parallel or banked raceways together, and on common supports where practical.

3.3.6.2 Bends in Parallel or Banked Runs:

Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

3.3.6.3 Elevations:

Install raceways at proper elevations. Provide adequate headroom.

3.3.7 Joints:

Join raceways with fittings designed and approved for the purpose and make joints tight.

3.3.7.1 Bonding Locknuts and Bushings:

Use bonding locknuts and bushings at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

3.3.7.2 Insulating Bushings:

Use insulating bushings for all conduits to protect conductors.

3.3.8 Pull Wire:

Install pull wires in empty raceways. Use #14 AWG zinc-coated steel or monofilament plastic line having not less than 200-LB tensile strength. Leave not less than 24 inches of slack at each end of the pull wire.

3.3.9 Stub-Up Connections:

Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit. Flexible conduit may be used 6 inches above the floor/pad in coordination with PM Designee. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

3.3.10 Flexible Connections:

3.3.10.1 Flexible, Liquid-Tight Metal Conduit:

Characteristics:

- a. Use maximum of 6 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; in wet or damp outdoor locations; and for all motors.
- b. May be used for branch circuits in lengths longer than 6 feet in computer room locations which meet requirements of NEC Article 645.
- c. Fittings and junction boxes must be liquid tight under raised floors.

3.3.10.2 Separate Ground Conductor:

A separate ground conductor must be provided across all flexible conduit in addition to the equipment ground conductor run in the conduit with its related power conductors. This conductor must be bonded to the connecting

device at each end of the flexible conduit.

3.3.11 Boxes:

3.3.11.1 Boxes in Wiring or Raceway System:

Boxes must be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices and fixtures. Each box must have the volume required by the NFPA 70 for the number and size of conductors in the box.

1. Pull/Junction Boxes: Installation must be plumb and level. Bring pull boxes tops flush with finished grade. Install type suitable for location (interior/exterior, dry/damp/wet).
2. Outlet Boxes: Each outlet box must have a machine screw which fits into a tapered hole into the box for the ground connection.
3. Wet locations: Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces must be gasketed.
4. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
5. Support boxes in accordance with Section 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS. Minimum support must be at each corner.
6. EMT entering an enclosure without threaded hubs: Provide a connector with threads and cast or machine locknut. The connector body and locknut must be installed so that firm contact is made on each side of the enclosure.
7. Ends of conduit not terminated in boxes or cabinets must be capped to protect against entry of dirt and moisture.
8. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors in accordance with other sections of the specification.

3.3.11.2 Coordination:

Coordinate with other trades and determine proper placement and mounting heights of all devices.

3.3.12 Grounding:

Install grounding connections for raceway, boxes, and components in accordance with Section 26 05 26.

3.3.13 Protection

Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

3.3.13.1 Galvanized Finish Damage Repair:

Repair damage to galvanized finishes with zinc-rich paint recommended by

manufacturer.

3.3.13.2 Paint Finish Damage Repair:

Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

3.4 ADJUSTING AND CLEANING

3.4.1 Inspection:

Upon completion of installation of system, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions and cover raceways and boxes to prevent entrance of foreign matter, paint, etc.

3.4.2 Dirt and Debris Removal:

Remove dirt and construction debris from outlet, junction, and pull boxes, and cabinets. Deformed raceways, boxes, cabinets and enclosures must be replaced.

3.4.3 Swab or Mandrel through Raceways:

Run a swab or mandrel to remove dirt or blockages from raceways.

-- End of Section --

Cable Ties

Paint

SD-04 Samples

Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY CONTROL

1.4.1 Electrical Component Standard:

Components and installation must comply with NFPA 70 latest edition.

1.4.1.1 ANSI Compliance:

Comply with requirements of ANSI A13.1, "Scheme for Identification of Piping Systems", with regard to type and size of lettering for raceway and cable labels.

1.4.1.2 National Fire Protection Association (NFPA):

Comply with NFPA 70, latest edition, requirements for Identification and for provision of warning and caution signs for wiring and equipment.

1.5 SEQUENCING AND SCHEDULING

Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Materials:

Materials must be in accordance with FAA-C-1217, latest edition.

2.1.2 Standard Products:

Except as otherwise noted provide manufacturer's standard products of categories and types required for each application.

2.1.3 Lettering, Colors, and Graphics:

Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Provide numbers, lettering and wording as approved in submittals as required by code or as recommended by the manufacturer.

2.2 RACEWAY AND CABLE LABELS

2.2.1 Manufacturer's Standard Products:

Where more than one type is listed for a specified application, selection is Subcontractor's option, but provide single type for each application

category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

2.2.2 ANSI Compliance:

Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

2.2.2.1 Color:

White legend on a black field.

2.2.2.2 Legend:

Indicates voltage and source/service (and termination point for control cables).

2.2.3 Adhesive Labels:

Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather- and chemical-resistant coating.

2.2.4 Engraved Plastic-Laminated Nameplates:

Provide nameplates for all new equipment to match existing nameplates at site.

2.2.5 Pre-tensioned, Wrap-around Plastic Sleeves:

Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

2.2.6 Tape Labels:

Embossed adhesive tape with 1/4 inch (minimum) white letters on a black background.

2.2.7 Colored Adhesive Tape:

Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2.8 Underground Line Warning Tape:

Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

2.2.8.1 Size:

Not less than 6 inches wide by 4 mils thick.

2.2.8.2 Compounding:

Compounded for permanent direct-burial service.

2.2.8.3 Embedding:

Embedded continuous metallic strip or core.

2.2.8.4 Printed Legend:

Indicates type of underground line.

2.2.9 Tape Markers:

Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters for Designation purposes.

2.2.10 Aluminum, Wraparound Marker Bands:

Wrap-around bands cut from 0.014-inch-thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

2.2.10.1 Plasticized Card-Stock Tags:

Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

2.2.11 Copper, Brass or Aluminum Tags:

Metal tags with stamped legend, punched for fastener. Dimensions: Tags must be circular in shape, two inches minimum diameter, by 0.02 inch thick for copper or by 0.05 inch thick for brass or aluminum.

2.3 ENGRAVED NAMEPLATES AND SIGNS

2.3.1 Manufacturer's Standard Products:

Where more than one type is listed for a specified application, selection is the installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

2.3.2 Engraving Stock:

Melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 sq. in. or 8 inches in length; 1/8 inch thick for larger sizes. Minimum width of engraving stock must be 2 times letter height.

2.3.3 Engraved Legend:

Engraved three layer laminated plastic white letters on black background.

2.3.4 Letter Height:

Lettering for equipment identification must be 3/8 inch high. Voltage rating and source lettering must be 1/4 inch high.

2.3.5 Baked-Enamel Signs for Interior Use:

Preprinted aluminum signs, punched for mechanical fasteners, with colors, legend, and size as indicated or as otherwise required for the application. Use 1/4-inch grommets in corners for mounting.

2.3.6 Wire and Cable Markers:

Cloth markers, split sleeve or tube type.

2.3.7 Exterior, Metal-Backed, Butyrate Signs:

Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. Use 1/4-inch grommets in corners for mounting. Signs must be punched for mechanical fasteners.

2.3.8 Fasteners for Plastic-Laminated and Metal Signs:

Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3.9 Tape Labels:

Embossed adhesive tape with 1/4 inch (minimum) white letters on a black background.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

2.4.1 Cable Ties:

Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:

2.4.1.1 Minimum Width:

3/16 inch.

2.4.1.2 Tensile Strength:

50 lb minimum.

2.4.1.3 Temperature Range:

Minus 40 to 185 deg F.

2.4.2 Paint:

Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION:

3.1.1 Existing Nameplates:

Install nameplates for all new equipment to match existing nameplates on site.

3.1.2 Consistency:

Use consistent designations throughout the Project

3.1.3 Sequence of Work:

Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.1.3.1 Self-Adhesive Identification Products:

Degrease and clean surfaces of dust, loose material, and oily films before applying.

3.1.4 Raceway/Cable Identification of Special Systems:

Identify raceways and exposed cables of special systems with color banding and black lettering appropriately sized for conduit. Band exposed and accessible raceways of the systems listed below for identification.

3.1.4.1 Bands:

Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit place adjacent bands of 2-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.

3.1.5 Circuit Identification Labels on Boxes:

Label externally as follows:

3.1.5.1 Exposed Boxes:

Pressure-sensitive, self-adhesive plastic label, as well as "magic marker" on cover.

3.1.5.2 Labeling Legend:

Permanent, waterproof listing of panel and circuit number or equivalent.

3.1.6 Underground Utility Line Warning Tape:

During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker with metallic tracer located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches, use a single line marker.

3.1.6.1 Line Marker:

Install line marker for underground wiring, both direct buried and in raceway.

3.1.7 Color Code Conductors:

The following field-applied color-coding methods may be used in lieu of factory-coded wire listed in part 2 of Section 26 05 19 LOW VOLTAGE WIRES AND CABLES for sizes larger than No. 4 AWG. Demonstrate non-availability of factory colored wire before using this application.

3.1.7.1 Colored, Pressure-Sensitive Plastic Tape:

Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to

prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

a) Where conductors are color coded by this method, they must be color coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations. Conductors in accessible raceways must be color coded so that by removing or opening any cover, the coding will be visible.

1) Green insulated conductors must not be re-identified for purposes other than grounding.

2) White or neutral gray conductors must not be re-identified for purposes other than grounded neutrals.

3.1.8 Power Cable Identification:

Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in pull boxes, junction boxes, handholes, switchgear rooms, switchboard rooms, engine generator rooms, UPS rooms, and all electrical closets.

3.1.8.1 Legend:

1/4-inch letter and number, stamping or embossing, with legend corresponding to indicated circuit designations.

3.1.8.2 Fastening:

Fasten tags with cable ties; fasten bands using integral ears.

3.1.9 Conductor Identification for Other Systems:

Install cable tags in each handhole with not less than two tags per cable, one near each duct entrance hole.

3.1.9.1 Tag Attachment:

Attach tags to cable immediately after installation.

3.1.9.2 Cable Terminations:

Cable terminations must be tagged as to function.

3.1.9.3 Nylon Cord:

Attach securely to cable using 1/8-inch nylon cord.

3.1.10 Signage:

Install warning, caution, and instruction signs as follows:

3.1.10.1 Sign Installation:

Install signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment

operation. Install butyrate signs with metal backing in outdoor locations.

3.1.11 Identification Labels:

Install identification labels as follows:

3.1.11.1 Application:

Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. The first line must show the equipment ID, the second line must show the voltage and source.

3.1.12 Equipment Labeling:

Apply labels for each unit of the following categories of equipment:

3.1.12.1 Panelboards, Electrical Cabinets, and Enclosures

3.1.12.2 Access Doors and Panels for Concealed Electrical Items

3.1.12.3 Transformers

3.1.12.4 Disconnect Switches

3.1.12.5 Enclosed Circuit Breakers

3.1.12.6 Application:

Apply identification labels of engraved plastic laminate for disconnect switches, enclosed breakers, and similar items for power distribution and control components above, except panelboards where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.1.13 Locations:

Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

3.1.14 Cable Tagging:

Tag cables in each handhole with not less than two tags per cable, one near each duct entrance hole.

3.1.14.1 Tag Attachment:

Attach tags to cable immediately after installation.

3.1.14.2 Cable Terminations:

Cable terminations must be tagged as to function.

3.1.14.3 Nylon Cord:

Attach securely to cable using 1/8 inch nylon cord.

3.1.15 Updating Panel Schedules:

Update all panelboards, new or existing, that have been modified by adding, removing, or relocating circuits. See panelboard schedules in electrical drawings.

-- End of Section --

UL Solutions (UL)

UL 50	Electrical Cabinets and Boxes
UL 67	Panelboards
UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualification Data: For firms and persons specified in "Quality Assurance" Article.

SD-02 Shop Drawings

For panelboards, include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, voltage, and current rating. Include the following:

- a. Enclosure type with details for types other than NEMA 250, Type 1
- b. Bus configuration and current ratings
- c. Short-circuit current rating of panelboard
- d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components

SD-03 Product Data

For each type of panelboard, circuit breaker, accessory item and component specified, include outline and support point dimensions, voltage, circuit breaker data arrangement and size.

SD-06 Test Reports

Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include certified infrared scanning reports.

SD-08 Manufacturer's Instructions

Include manufacturer's written instructions for testing circuit breakers.

SD-10 Operation and Maintenance Data

For panelboard components included in the maintenance manuals specified in Section 26 05 00.10 BASIC ELECTRICAL MATERIALS AND

METHODS.

SD-11 Closeout Submittals

Panelboard Schedule: For installation in panelboards. Submit final versions after load balancing.

1.4 QUALITY CONTROL

1.4.1 Testing Agency Qualification Data:

Independent testing agency must meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7 (29CFR1910.7), or must be a full member company of NRTL.

1.4.1.1 Testing Agency's Field Supervision:

Person currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET), to supervise on-site testing specified in Part 3 of this section.

1.4.2 Listing and Labeling:

Provide products specified in this Section that are listed and labeled.

1.4.2.1 The Terms "Listed" and "Labeled:"

As defined in the National Electrical Code, Article 100.

1.4.2.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

1.4.3 NFPA Compliance:

Comply with NFPA 70, National Electrical Code, latest edition.

1.4.4 NEMA Compliance:

Comply with NEMA PB1, Panelboards.

1.4.5 Single Source Responsibility:

Panelboards and circuit breakers located in the panelboards must be the product of a single manufacturer.

1.5 EXTRA MATERIALS

Keys: Furnish two (2) keys to FAA for each panelboard installed.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

2.2 PANELBOARD FABRICATION

2.2.1 Panelboard Type:

Panelboards must be of box dead-front type with circuit breaker equipped and must conform to Federal Specification FS W-P-115, Type I, Class 1 and must also be listed by an NRTL except for installations which require special panelboards to incorporate items not available as NRTL listed.

2.2.2 Enclosures:

UL 50, general purpose, galvanized sheet steel, surface-mounted cabinets with a baked-on gray enamel over a rust inhibitor as indicated on the drawings. Panelboards must be listed and labeled by an NRTL and must conform to the latest requirements of the National Electric Code latest edition, and of NEMA PB1, Type 1, Class 1, unless otherwise indicated to meet environmental conditions at installed locations.

2.2.3 Directory Frame:

Metal, mounted inside each panelboard door.

2.2.4 Main Bus:

Hard drawn copper of 98 percent conductivity must meet UL 67 temperature rise limits, and have a current density of 1000 amperes per square inch. Bus bars must be sequenced-phased, and rigidly supported by high impact resistant, insulated bus supporting assemblies to prevent vibration or short circuits. Solderless terminations must be suitable for copper NRTL listed wire or cable and must be tested and listed in conjunction with appropriate NRTL standards.

2.2.4.1 Bus Capacity:

Bus capacity as indicated on Contract Drawings, or equal to or greater than the panelboard overcurrent protection device.

2.2.4.2 Bus Bars:

Bus bars connections to bolt on branch circuit breakers must be of the sequence phase type.

2.2.4.3 Provisions:

Where provisions for "future" or "space" are noted on the drawings the panelboard must be equipped with bus connections for the future installation of circuit breakers.

2.2.4.4 Sequencing:

Sequence style busing to accept bolt on molded case circuit breakers.

2.2.5 Neutral Bus:

2.2.5.1 Neutral Bar:

The neutral bar must be fully rated and capable of being located in either corner of the enclosure at the line ends to facilitate conductor termination and must be insulated from panelboard.

2.2.5.2 Copper Bus Bar:

Neutral bus bar must be copper or plated copper and insulated from panelboard.

2.2.5.3 Isolation:

The neutral bus must be isolated from all other busses except where the panelboard is used as the service disconnecting means.

2.2.6 Equipment Ground Bus:

Ground bus must be copper, and adequate for feeder and branch-circuit equipment ground conductors with 25 percent additional space for future connections. Lugs must be sized to accommodate grounding conductors shown on Contract Drawings.

2.2.6.1 Securely Bonded Ground Bus:

The ground bus must be securely bonded to the cabinet and must be separate from the neutral bus.

2.2.6.2 Lug Terminations:

The number of lug terminations must be at least equal to the number of poles in the panelboard.

2.2.6.3 Ground Bus Bar Attachment to Panelboard:

The ground bus bar must be structurally integral to the panelboard, or attached to the panelboard with a bolt, nut, and lock washer.

- a. Bond conductor must have same current carrying capacity as the largest equipment grounding conductor terminated to the ground bus bar.

2.2.7 Short Circuit Rating:

Panelboards must be fully rated for short circuit. See Contract Drawings for short circuit rating.

2.2.8 Future Devices:

Equip phase busses with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.

2.2.9 Panelboard Features:

Include the following special features for panelboards.

2.2.9.1 Hinged Front Door in Door Construction:

Entire front trim hinged to box with standard door within hinged trim cover (one-piece front with two doors). The smaller door, when open, provides access to device handles and rating labels and must be lockable. The larger door, when open, provides access to conductors and wiring terminals. Door hinges must be continuous piano hinges that are welded to

the door(s) and bolt on front. All door hinges must be concealed.

2.2.9.2 Channel/Wiring Space:

Must be four inches wide for power feeders up to and including 100 amperes, six inches wide for power feeders over 100 amperes and up to and including 225 amperes, and eight inches wide for power feeders over 225 amperes and up to 600 amperes.

2.2.9.3 Skirt for Surface-Mounted Panelboards:

Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.

2.2.9.4 Subfeed:

Overcurrent protective device or lug provision as shown on Contract Drawings.

2.2.9.5 Doors:

Doors must have flush type cylinder locks and catches. All locks in a project must be keyed alike, and 2 keys must be furnished with each lock.

2.2.10 Wire Gutter Size:

The minimum size of the side wiring gutters must be 4 inches for power feeders up to and including 100 Amperes, 6 inches for power feeders over 100 Amperes and up to 225 Amperes and 8 inches for panelboards over 225 Amperes up to 600 Amperes.

2.3 OVER-CURRENT PROTECTIVE DEVICES

2.3.1 Molded-Case Circuit Breaker:

NEMA AB1, UL 489, FS W-C-375, and the following requirements:

2.3.1.1 Molded Case Type:

Circuit breaker must be molded case type.

2.3.1.2 Bolt-On Type:

Circuit breaker must be bolt-on type. Stab-in and plug-in types are not acceptable.

2.3.1.3 Quick Make, Quick Break:

Quick make, quick break connections with mechanical trip, free switching mechanism.

2.3.1.4 Thermal Trip:

Inverse time, thermal trip for overloads. Automatic release secured by bi-metallic thermal element releasing the mechanism latch. Thermal trip calibrated for 40 degree C ambient temperature.

2.3.1.5 Magnetic Trip:

Instantaneous magnetic trip armature for short circuits.

2.3.1.6 Common Trip:

Multiple circuit breakers must have an internal, common trip mechanism to open all poles simultaneously.

2.3.1.7 Automatic Trip:

Automatic trip indication as a color change in the trip indicator window and by a handle position between the manual "OFF" and "ON" positions.

2.3.1.8 Single-Pole Breakers:

Single-pole breakers must be full size modules. Half sized breakers must not be allowed.

2.3.1.9 Two and Three Pole Breakers:

Two and three pole breakers must be sized in multiples of a single-pole breaker.

2.3.1.10 Branch Circuits:

Branch circuits must be connected to the circuit numbers as indicated on Contract Drawings.

2.3.1.11 NRTL Marking:

NRTL marked as suitable for use with 75 deg C wire.

2.3.1.12 No Series Ratings:

Series ratings of breakers must not be permitted.

2.3.2 Characteristics:

Provide frame size, trip rating, number of poles, auxiliary devices, voltage rating and interrupting capacity rating to meet available fault current as indicated on Contract Drawings.

2.3.2.1 Minimum Interrupting Rating:

10,000 AIC.

2.3.2.2 Interrupting Capacity:

Where the panelboard interrupting capacity is not indicated on the Contract Drawings, the circuit breaker interrupting capacity must be equal to or greater than the available fault current at the panelboard.

2.3.3 Circuit Breakers, 200 A and Larger:

Provide trip units interchangeable within frame size.

2.3.4 Lugs:

Provide mechanical lugs and power-distribution connectors for number per phase, size, and material of conductors indicated on Contract Drawings.

2.3.5 Single Manufacturer:

All circuit breakers and the panelboard in which the breakers are installed must be products of the same manufacturer.

2.3.6 Mains:

Panelboards must have either main lugs or main circuit protective device as scheduled.

2.3.7 Replacement:

Provide bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.3.7.1 Branch Circuit Connections:

Branch circuits must be connected to the individual circuit breakers as indicated on contract drawings.

2.4 ACCESSORY COMPONENTS AND FEATURES

Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 EXECUTION

3.1 GENERAL

Comply with manufacturer's written instructions and requirements in accordance with the direction of the PM Designee.

3.2 INSTALLATION

3.2.1 Materials:

Materials procured and installed in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

3.2.2 Mounting Heights:

Install panelboards and accessory items according to NEMA PB-1.1 and with applicable codes at each location indicated on the plan. Mount the top of the panelboard trim at 78 inches from the ground, unless otherwise indicated.

3.2.3 Mounting Tall Panelboards:

Panelboards greater than 90 inches tall must be mounted directly on the floor or maintenance pad, as shown on Contract Drawings.

3.2.4 Mounting:

Plumb and rigid without distortion of box. Mount flush panelboards

uniformly flush with wall finish.

3.2.5 Circuit Directory/Panelboard Schedule:

Type directory to include installed circuit loads after balancing panelboard loads. The directory must be arranged so that typed entries simulate circuit breaker positions in the panelboard. The directory must be mounted on the inside of the door in a holder with a protective covering. Obtain approval from the PM Designee before installing.

3.2.6 Filler Plates:

Provide and install filler plates for unused spaces in panelboards.

3.2.7 Wiring in Panelboard Gutters:

Arrange conductors into groups, and bundle with wire ties after completing load balancing.

3.3 IDENTIFICATION

3.3.1 Component Identification:

Identify field-installed wiring as specified in Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.3.2 Panelboard Nameplates:

Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws, as specified in Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.3.3 Warning Signs:

Provide warning signs as specified in Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.4 GROUNDING:

3.4.1 Termination:

Terminate ground connections in panelboards in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

3.4.2 Tightening Torque:

Tighten electrical connectors and terminals, including ground connections, according to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4.3 Ground Bus Bar:

If ground bus bar is mounted to enclosure with screw threads only (i.e., tapped blind hole), a separate bolted ground lug must be installed on the panelboard and bonded to the ground bus bar.

3.5 FIELD QUALITY CONTROL

3.5.1 Preparation:

Prepare for acceptance tests as follows:

3.5.1.1 Load Currents:

Measure and record steady-state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits on the panelboards to balance the phase loads within 10 percent.

3.5.1.2 Proper Phasing:

Take care to maintain proper phasing for multi-wire branch circuits.

3.5.1.3 Megger Tests:

Perform insulation-resistance megger tests of each panelboard bus, component, and connecting supply, feeder, and control circuits to main service ground.

3.5.1.4 Continuity and Phasing:

Make continuity and phasing tests of each circuit.

3.5.1.5 Ground Continuity Tests:

Perform ground continuity tests on main electrical ground bus to inspect for physical damage, proper alignment, anchorage, and grounding.

3.5.1.6 Proper Connections:

Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.5.2 Demonstration:

After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

3.5.2.1 Procedures:

Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches, and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

3.5.2.2 Correction:

Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3.5.2.3 Minimum Spare Capacity:

Check each panelboard to ensure that it contains a minimum of 20 percent spare capacity for future use.

3.6 ADJUSTING:

Set field-adjustable switches and circuit breaker trip ranges as indicated.

3.7 CLEANING:

Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and marred finishes to match original finish.

-- End of Section --

SECTION 26 27 26
LOW VOLTAGE WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

This Section includes various types of receptacles, multi-outlet assemblies, lighting switches, and finish plates.

1.1.2 Complete Installation:

Furnish and completely install lighting switches, convenience and multi-outlet assemblies, special purpose receptacles, etc., along with appropriate outlet boxes, trim and finish plates, etc., as indicated on the drawings and schedules and as herein specified.

1.1.3 Supplying Appropriate Devices:

Where connection to an item of equipment is required under this contract, and where such equipment requires a wiring device (special purpose receptacle) for connection, Furnish and install the appropriate device, whether or not the device is specifically shown or specified.

1.2 REFERENCES

Applicable only to the extent specified.

Federal Specifications (Fed Spec)

Fed Spec W-C-596	General and Associated Detailed Specifications: Connector, Plug Receptacle, and Cable Outlet, Electrical Power
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Fed Spec W-S-896	Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification)
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National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code (NEC), latest edition
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Occupational Safety and Health Administration (OSHA)

29CFR1910.7	Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
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UL Solutions (UL)

UL 20	General Use Snap Switches
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UL 498	Electrical Attachment Plugs and Receptacles
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UL 943	Ground Fault Circuit Interrupters
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1.3 SUBMITTALS

Parsons' approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Provide Component catalog numbers and manufacturer's data sheets, including pertinent data identifying each component by the item number and nomenclature, as specified.

General Purpose Duplex Receptacle

Receptacles, Straight-Blade

Ground-Fault Circuit Interrupter Receptacles

Weatherproof Receptacles

Special Purpose Or Heavy-Duty Receptacles

Snap Switches

Single-Pole And Three-Way Wall Switches

Wire Terminals

SD-10 Operation and Maintenance Data

Operation and maintenance data for materials and products specified in this Section to be included in Section 26 05 00.10 BASIC ELECTRICAL MATERIALS AND METHODS.

1.4 QUALITY CONTROL

1.4.1 Compliance:

Comply with NFPA 70, NEC, latest edition, for devices and installation.

1.4.2 Listing and Labeling:

Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

1.4.2.1 The Terms "Listed" and "Labeled":

As defined in the NEC, Article 100.

1.4.2.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

1.4.3 Manufacturer Qualifications:

The manufacturer must be a company specializing in the manufacturing products specified in this Section with a minimum of five (5) years experience.

1.5 COORDINATION:

1.5.1 Wiring Devices for Government Furnished Equipment:

Match devices to plug connectors for Government-furnished equipment.

1.5.2 Device Plates:

Device plates must be stainless steel, brushed finish. Convenience receptacles must be brown; computer receptacles must be ivory; and receptacles for critical circuits must be red in color.

PART 2 PRODUCTS

2.1 GENERAL:

2.1.1 Materials:

Materials procured and installed in this Section must be in accordance with:

2.1.1.1 FAA-C-1217, latest edition

2.1.1.2 FAA-STD-019, latest edition

2.1.2 Wiring Devices of Same Type:

All wiring devices of any one general type (e.g., all duplex receptacles, all wall switches etc.) must be of the same manufacturer and must match throughout.

2.2 WIRING DEVICES

2.2.1 NEMA Compliance:

Comply with NEMA WD 1, "General Purpose Wiring Devices," and UL approved, specification grade.

2.2.2 Enclosures:

NEMA 1 equivalent, except as otherwise indicated. Exterior receptacles must be mounted in waterproof cast outlet boxes with waterproof covers.

2.2.3 Receptacles, General:

All receptacles must be specification grade in accordance with NEMA WD 1. Wiring terminals must be of the screw-type. Receptacles with push-in connections or a combination of screw-type and push-in connectors are not acceptable.

2.2.4 Straight-Blade:

Except as otherwise indicated, comply with Fed Spec W-C-596 and heavy-duty grade of UL 498, "Electrical Attachment Plugs and Receptacles." Provide NRTL labeling of devices to verify these compliances.

2.2.5 General Purpose Duplex Receptacle:

125 volt, 20 Ampere, 2 pole, 3 wire grounded, with polarized slots, NEMA

5-20R.

2.2.6 Receptacles, Straight-Blade, Special Features:

Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:

2.2.7 Ground-Fault Circuit Interrupter Receptacles:

UL 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R (UL Group I, Class A), duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Contact arrangement must be such that contact is made on two sides of an inserted blade. Receptacle must be side or back wired with two screws per terminal. The grounding screw must be connected to the metal mounting yoke.

2.2.8 Weatherproof Receptacles:

Weatherproof Receptacles must be mounted in a box with a gasketed cover.

2.2.9 Special Purpose or Heavy-Duty Receptacles:

Must be of the type, rating and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle type plug of the same configuration must be furnished with each receptacle.

2.2.10 Wall Switches:

2.2.10.1 Snap Switches:

AC switches, NRTL listed and labeled as complying with UL 20 "General Use Snap Switches" and with Fed Spec W-S-896.

2.2.11 Single-Pole and Three-Way Wall Switches:

Single-pole and three-way wall switches must be specification grade, 120/277 volts, and must be fully rated 20 amperes AC only, totally enclosed toggle type with bodies of phenolic compound.

2.2.12 Wire Terminals:

Wire terminals must be of the screw type.

2.2.13 Switch Connections:

Switches with push-in connections or a combination of screw type and push-in connectors are not acceptable.

2.2.14 Switch Type:

Switches must be the quiet-operating type.

2.2.15 Switch Handles:

Switch handles must be ivory in color.

2.2.16 Devices and Devices Plates:

Provide device plates of one-piece type to suit the devices installed.

2.2.16.1 Plate Screw:

Plate screw must be metal with countersunk head, in a color to match the finish of the plate.

2.2.16.2 Device Plates:

Provide device plates as follows:

- a. Brushed stainless steel in unfinished areas (e.g. ALSF Shelter).
- b. Gasketed in wet locations.

2.2.16.3 Intercommunications Outlets:

Intercommunications outlets must be provided with a blank cover plate unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Arrangement of Devices:

Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multi-gang wall plates.

3.1.2 Gang-Type Plates:

Where two or more devices indicated for gang installation, they must be trimmed with gang type plates. Sectional Plates are not acceptable.

3.1.3 Positioning:

Install devices and assemblies tightly to boxes and adjusted plumb, level.

3.1.4 Receptacle Height:

Receptacles must be installed 18 inches 12 inches above finished floor, unless noted otherwise.

3.1.5 Wall Switch Height:

Wall switches must be installed 48 inches above finished floor, unless noted otherwise.

3.1.6 Grounding Pole Position:

Install receptacles with grounding pole on the bottom.

3.1.7 Wall Switch Installation:

3.1.7.1 Single Gang Position:

Not more than one switch must be installed in a single gang position.

3.1.7.2 Grounding:

Where switches have grounding terminals, they must be grounded with a green grounding pigtail connected from the switch grounding screw directly to the grounding lug on the outlet box where the green equipment grounding conductor is terminated.

3.1.7.3 Off Position:

Install switches with Off position down.

3.1.8 Device Plate Installation:

3.1.8.1 Finished Wall Surfaces:

Plates must be installed with all four edges in continuous contact with finished wall surfaces without use of mats or similar devices.

3.1.8.2 Wet Locations:

Plates installed in wet locations must be gasketed.

3.1.8.3 No Sectional Type Device Plates:

Use of sectional type device plates must not be permitted.

3.1.8.4 No Plastic Rings:

Plastic rings must not be permitted.

3.1.8.5 Sequencing:

Install wall plates after painting is complete.

3.1.9 Protection:

Protect devices and assemblies during painting.

3.1.10 Compliance:

Install products in accordance with the manufacturer's instructions.

3.2 IDENTIFICATION

Comply with Section 26 05 53 IDENTIFICATION OF ELECTRICAL SYSTEMS.

3.3 GROUNDING

The green insulated equipment grounding conductor, run with the power conductors, must terminate at the device yoke grounding screw. In addition to this ground connection, install a #12 AWG jumper from the device yoke grounding screw to device box grounding lug screw.

3.4 FIELD QUALITY CONTROL:

3.4.1 Testing:

Test wiring devices for proper polarity, continuity and operation.

3.4.2 GFCI Testing:

Test ground-fault circuit interrupter (GFCI) operation with both local and remote fault simulations according to manufacturer's recommendations.

3.4.3 Switch Testing:

Test that each switch operates properly 6 times in succession.

3.4.4 Verification:

Verify that each receptacle device is energized.

3.4.5 Replacement:

Replace damaged or defective components.

3.5 CLEANING

Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

-- End of Section --

(NRTL)

UL Solutions (UL)

UL 486A

Wire Connectors and Soldering Lugs for Use
with Copper Conductors

1.3 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Include outline drawings with dimensions and equipment ratings for voltage, capacity and short circuit.

SD-03 Product Data

For switches, circuit breakers and accessories specified in this Section. Include the following:

- a. Voltage rating
- b. Current trip rating
- c. Short circuit rating
- d. Fuse rating
- e. Type of enclosure
- f. Circuit frame size, trip rating, and number of poles
- g. Fuses
- h. Disconnect Switches
- i. Molded Case Circuit Breakers

SD-06 Test Reports

Field test reports indicating and interpreting test results.

SD-08 Manufacturer's Instructions

Manufacturer's Written Instructions

1.4 QUALITY CONTROL

1.4.1 Single Source Responsibility:

Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

1.4.2 NFPA Compliance:

Comply with NFPA 70 latest edition for components and installation.

1.4.3 Listing and Labeling:

Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.

1.4.3.1 The Terms "Listed" and "Labeled":

As defined in the National Electrical Code, Article 100.

1.4.3.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured and installed in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

2.2 FUSES

Refer to Section 26 28 13 FUSES for fuse requirements.

2.3 DISCONNECT SWITCHES

2.3.1 General:

Switches must be heavy duty, fusible or non-fusible of the voltage, phase, and current ratings indicated on the Contract Drawings. Switches must be the quick-make, quick-break type. Except for ground lugs which must be bonded to the housing, parts must be mounted on insulating bases to permit replacement of any part from the front of the switch. All current carrying parts must be of high conductivity copper unless otherwise specified and must be designed to carry rated current without excessive heating. Switch contacts must be silver tungsten or plated to minimize corrosion, pitting and oxidation and to assure suitable conductivity. Switch handle must be lockable in either the "ON" or "OFF" position.

2.3.1.1 Lugs:

Provide lugs to accept more than one conductor per phase as required for application. Landing multiple conductors in a single lug is not acceptable.

2.3.1.2 Padlocks:

Provide 2 padlocks for each switch. Coordinate padlock selection with SSC prior to procurement.

2.3.1.3 Handle:

Handle interlocked with cover in the "CLOSED" position.

2.3.2 Enclosed, Non-fusible Switch:

NEMA KS 1, Type HD

2.3.3 Enclosed, Fusible Switch:

NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, and provide rejection type fuse clips with switches.

2.3.4 Enclosure:

NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location:

2.3.4.1 Outdoor Locations:

Type 4X, unless otherwise noted on drawings or other contract documents.

2.3.4.2 Fabrication:

Fabricate enclosure from steel.

2.3.4.3 Finish:

Finish using manufacturer's standard enamel finish, gray color.

2.4 MOLDED CASE CIRCUIT BREAKERS

2.4.1 General:

NEMA AB 1, UL 489, Fed Spec W-C-375, lockable handle, with 2 padlocks complying with Fed Spec W-C-375, and the following requirements:

2.4.1.1 Molded Case Type

2.4.1.2 Connections:

Bolt-on type, quick make, quick break connections with mechanical trip, free switching mechanism

2.4.1.3 Trips and Releases:

Inverse time, thermal trip for overloads. Automatic release secured by bi-metallic thermal element releasing the mechanism latch. Thermal trip calibrated for 40 degree C ambient temperature.

2.4.1.4 Magnetic Armature:

Magnetic armature must be provided to trip the breaker instantaneously for short-circuit currents above the overload range.

2.4.1.5 Automatic Tripping:

Automatic tripping must be indicated by a handle position between the manual "OFF" and "ON" positions.

2.4.1.6 Multi-Phase Circuit Breakers:

Multi-phase circuit breakers must have an internal, common trip mechanism to open all poles simultaneously.

2.4.1.7 Mechanical Lugs:

Circuit breaker must have mechanical lugs and power distribution connectors sufficient for the number, size, and material of the conductors indicated. Provide lugs to accommodate multiple conductors per phase as required for application. Landing multiple conductors in a single lug is not acceptable.

2.4.1.8 Padlocking:

Include provisions for padlocking.

2.4.1.9 Poles:

Provide poles as indicated on Contract Drawings.

2.4.1.10 Ratings:

Provide ratings as indicated on contract drawings.

- a. Minimum interrupt rating at 240V: 22,000 AIC symmetrical
- b. Voltage rating 120/240V.
- c. Current rating as indicated on Contract Drawings.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surfaces:

Verify that surfaces are ready to receive work.

3.1.2 Field Measurements:

Verify field measurements are as shown on the drawings.

3.1.3 Utilities:

Verify that required utilities are available, in proper location and ready for hookup.

3.2 INSTALLATION

3.2.1 Standards Compliance:

Materials installed in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

3.2.2 Installation Location:

Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions and as required by the NEC and local codes.

3.2.3 Installation Practice:

Install disconnect switches level and plumb, and as required by the NEC

and local codes.

3.2.4 Circuit Connection:

Connect disconnect switches, circuit breakers and components to wiring system and to ground as indicated and in accordance with manufacturer's recommendations.

3.2.5 Torque Settings:

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.2.6 Circuit Identification:

Identify each disconnect switch and circuit breaker according to requirements specified in Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.2.7 Fuse Installation:

Install fuses in fused disconnect switches.

3.2.8 Fuses:

Refer to Section 26 28 13 FUSES for fuse requirements.

3.2.9 Termination:

Connecting more than one conductor to a phase lug is not acceptable.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing:

After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

3.3.2 Procedures:

Perform each visual and mechanical inspection and electrical tests stated in NETA ATS, Section 7.5 for disconnect switches, Section 7.6 and NEMA AB 1 for molded-case circuit breakers. Certify compliance with test parameters.

3.3.3 Correcting Malfunctions:

Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3.4 Visual Inspection:

Inspect visually and perform several "On-Off" operations on each circuit breaker.

3.3.5 Circuit Continuity:

Verify circuit continuity on each pole in the closed position.

3.4 CLEANING

After completing system installation, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches and abrasions.

-- End of Section --

1.4.2.1 The Terms "Listed" and "Labeled":

As defined in the "National Electrical Code," Article 100.

1.4.2.2 Listing and Labeling Agency Qualifications:

A NRTL as defined in OSHA Regulation 29CFR1910.7.

1.4.3 Single-Source Responsibility:

All fuses must be the product of a single manufacturer.

1.5 EXTRA MATERIALS

Furnish the following extra materials that match products installed, packaged with protective covering for storage, and with identification labels clearly describing contents.

1.5.1 Spare Fuses:

A complete set of fuses must be installed and one set of spares must be furnished for each fusible device.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured and installed in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

2.2 CARTRIDGE FUSES

Characteristics - NEMA FU 1 nonrenewable cartridge fuse, class as specified or indicated, current rating as indicated, voltage rating consistent with circuit voltage.

PART 3 EXECUTION

3.1 GENERAL

Comply with manufacturer's requirements for installation.

3.2 EXAMINATION

3.2.1 Fuse Identification:

Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

3.2.2 Pre-Installation:

Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

3.4 IDENTIFICATION

Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

-- End of Section --

**SECTION 26 51 00
INTERIOR LIGHTING**

PART 1 GENERAL

1.1 SUMMARY

This Section includes furnishing labor, materials, equipment, and incidentals necessary to install interior lighting fixtures, lamps, exit signs, and accessories.

1.2 REFERENCES

Applicable only to the extent specified.

American National Standards Institute (ANSI)

ANSI C78	Electric Lamps
ANSI C78.377	Specifications for the Chromaticity of Solid-State Lighting Products
ANSI LM-79	(2019) Approved Method: Electrical and Photometric Measurements of Solid State Lighting Products
ANSI/IES TM-30	(2020) Technical Memorandum: IES Method for Evaluating Light Source Color Rendition

Federal Specifications (FS)

FS W-L-305	Light Set, Emergency
FS J-C-30	Cable and Wire, Electrical

Federal Aviation Administration (FAA)

FAA-C-1217	Electrical Work, Premises Wiring
FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding, and Shielding Requirements for Facilities and Electronic Equipment

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code (NEC), latest edition
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Occupational Safety and Health Administration (OSHA)

29CFR1910.7	Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)
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UL Solutions (UL)

UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
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UL 924 Emergency Lighting and Power Equipment
UL 8750 Standard for Light Emitting Diode (LED)
Equipment for Use in Lighting Products.

1.3 DEFINITIONS

1.3.1 Fixture:

A complete lighting unit or exit sign. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.

1.3.2 Average Life:

The time after which 50 percent fail and 50 percent survive under normal conditions.

1.3.3 Luminaire:

Fixture.

1.4 SUBMITTALS

Parsons approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Outline drawings indicating dimensions and principal features of fixtures, lamp data, support points, weights and accessories for each luminaire type.

SD-03 Product Data

Submit product data describing fixtures, lamps, light sources, LED drivers, support points (i.e., suspended fixture support components), weights, accessories, exit lighting, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories.

SD-08 Manufacturer's Instructions

Manufacturer's installation instructions under general provisions.

SD-09 Manufacturer's Field Reports

Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps.

SD-10 Operation and Maintenance Data

Maintenance data for fixtures to include in the operation and maintenance manual.

SD-11 Closeout Submittals

Warranty

1.5 QUALITY ASSURANCE

1.5.1 Electrical Component Standard:

Provide components that comply with NFPA 70 and that are listed and labeled by an NRTL.

1.5.2 Listing and Labeling:

Provide fixtures and accessory components that are listed and labeled for their indicated use and installation conditions on the Project.

1.5.2.1 Special Listing and Labeling:

Provide fixtures for use in damp or wet locations, and recessed in combustible construction that are specifically listed and labeled for such use. Provide fixtures for use in locations classified as hazardous that are listed and labeled for the specific hazard.

1.5.2.2 The Terms "Listed" and "Labeled:"

As defined in the National Electrical Code, Article 100, latest edition.

1.5.2.3 Listing and Labeling Agency Qualifications:

An NRTL as defined in OSHA Regulation 29CFR1910.7.

1.5.3 Coordination:

Coordinate fixtures, mounting hardware, and trim with ceiling system and other items, including work of other trades, required to be mounted on ceiling or in ceiling space.

1.6 DELIVERY, HANDLING, AND STORAGE

Ship light fixtures inside protective cartons and keep packaged until installed. Deliver lamps to job site in the original packaging case and sleeves.

1.7 SITE CONDITIONS

1.7.1 Special Mounting, Enclosures, and Fire Safety:

Provide special mounting, enclosures, and fire safety, as required by the codes having jurisdiction so that the integrity of the NRTL listed ceiling assemblies is maintained.

1.7.2 NRTL Labels:

Provide NRTL labels where fixtures are subject to moisture.

1.8 EXTRA MATERIALS

Furnish extra materials that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents as described below:

1.8.1 Fixtures:

1 fixture for every 10 of each type and rating installed. Furnish at least one of each type.

1.8.2 Plastic Diffusers and Lenses:

1 for every 100 of each type and rating installed. Furnish at least one of each type.

1.8.3 Wire Guards:

1 for every 50 of each type installed. Furnish at least one of each type.

1.9 WARRANTY

1.9.1 General Warranty:

The special warranty specified in this Article must be in addition to, and run concurrent with, other warranties made by the Subcontractor under requirements of the Contract Documents.

1.9.2 Special Warranty LED Drivers:

Provide a written warranty signed by manufacturer and Subcontractor agreeing to replace LED drivers against defects in material or workmanship for a period of five years from the date of Substantial Completion. Defective LED drivers must be replaced within the warranty period at no cost to the Government.

PART 2 PRODUCTS

2.1 GENERAL

Materials procured and installed in this Section must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

2.2 FIXTURES, GENERAL

Comply with the requirements specified in the Articles below and lighting fixture schedule indicated on the Contract Drawings.

2.2.1 Lighting Fixtures Indicated in Contract Documents:

Provide the lighting fixtures as specified and scheduled on the Contract Drawings.

2.2.2 Substitutes:

Fixtures specified in the lighting fixture schedule on Contract Drawings establish a level of quality and appearance that any substituted fixtures must match or exceed. Submit substitutions for the specified fixtures to the PM Designee for approval.

2.2.3 NRTL Approved Lighting Fixtures:

All lighting fixtures must be NRTL approved and must bear an NRTL label.

2.2.4 Lamps:

LED light sources must be the length, type, wattage, and color as indicated on the Contract Drawings..

2.3 FIXTURE COMPONENTS, GENERAL:

2.3.1 Metal Parts:

Free from burrs and sharp corners and edges.

2.3.2 Sheet Metal Components:

Steel, except as indicated. Components are formed and supported to prevent warping and sagging.

2.3.3 Doors, Frames, and Other Internal Access:

Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.

2.3.4 Reflecting Surfaces:

Minimum reflectance as follows, except as otherwise indicated:

2.3.4.1 White Surfaces:

85 percent.

2.3.4.2 Specular Surfaces:

83 percent.

2.3.4.3 Diffusing Specular Surfaces:

75 percent.

2.3.4.4 Laminated Silver Metallized Film:

90 percent.

2.3.5 Lenses, Diffusers, Covers, and Globes:

100 percent virgin acrylic plastic except as otherwise indicated.

2.3.5.1 Plastic:

High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3.5.2 Lens Thickness:

0.125 inch minimum, except where greater thickness is indicated.

2.3.6 Wiring:

Fixture wiring must be thermoplastic insulated copper, rated for 600

volts, in accordance with FS J-C-30 and the NEC.

2.3.7 Flexible Conduit:

Flexible metal conduit is permitted for concealed interior installations only.

2.4 SUSPENDED FIXTURE SUPPORT COMPONENTS

2.4.1 Single-Stem Hangers:

1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

2.4.2 Twin-Stem Hangers:

Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

2.4.3 Rod Hangers:

1/4-inch minimum diameter, cadmium-plated, threaded steel rod.

2.4.4 Hook Hanger:

Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.5 LIGHT SOURCES

ANSI C78.377. Provide type, delivered lumen output, and wattage as indicated in the luminaire schedule on project plans.

2.5.1 LED Light Sources

Provide LED light sources that meet the following requirements:

- a. ANSI C78.377. Emit white light and have a nominal CCT of 4000 Kelvin.
- b. Minimum Color Rendering Index (CRI) of 90. Fidelity index greater than or equal to 80, gamut index between 97 and 110, determined in accordance with ANSI/IES TM-30.
- c. Restriction of Hazardous Substances (RoHS) compliant.
- d. Light source color consistency by utilizing a binning tolerance within a 3-step McAdam ellipse.
- e. Color maintenance value of no greater than 0.003 ($\Delta u'v'$) at 6000 hours as listed in ANSI LM-79 Test Report.

2.6 LED DRIVERS

UL 8750. Provide LED drivers that are electronic, UL Class 1 or Class 2, constant-current type and that comply with the following requirements:

- a. The combined driver and LED light source system does not exceed the minimum luminaire efficacy values as listed in the luminaire schedule provided.

- b. Operates at a voltage of 120 volts at 50/60 hertz, with input voltage fluctuations of plus/minus 10 percent.
- c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.
- d. Maximum Total Harmonic Distortion (THD) less than 20 percent at full input power and across specified dimming range.
- e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
- f. Withstands Category A surges of 2 kV without impairment of performance. Provide surge protection that is integral to the driver.
- g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.
- h. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- i. Class A sound rating.
- j. Restriction of Hazardous Substances (RoHS) compliant.

2.7 EXIT LIGHTING

Conform to UL 924 "Emergency Lighting and Power Equipment," and the following:

2.7.1 Sign Colors:

Conform to local code.

2.7.2 Minimum Height of Letters:

Conform to local code.

2.7.3 Arrows:

Include as indicated.

2.7.4 Lamps for AC Operation:

Light Emitting Diode (LED) array.

2.8 EMERGENCY LIGHTING

Conform to UL 924 "Emergency Lighting and Power Equipment," and Federal Specification FS W-L-305, Type I, Class 1, Style D or E, with the number of heads as indicated on the drawings and the following:

2.8.1 Housing:

Retractable with flush mounted door

2.8.2 Power Supply:

Remote nickel cadmium battery pack

2.8.3 Integral Test Module:

Self diagnostic monitoring system

2.8.4 Finish:

White powder coat finish to be custom painted to match surrounding finishes in the field.

2.8.5 Branch Circuits:

Connect to the same branch circuits that provide normal lighting to the area, ahead of any local switches.

2.9 LAMPS

2.9.1 Furnishing:

Furnish lamps for all fixtures in accordance with the lighting fixture schedule.

2.9.2 ANSI Compliance:

Conform to the ANSI C78 series applicable to each type of lamp.

2.10 FINISHES

Manufacturer's standard finish applied over corrosion-resistant treatment or primer, free of streaks, runs, stains, blisters, and similar defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.

PART 3 EXECUTION

3.1 GENERAL

Installation of lighting systems must be in accordance with FAA-C-1217 and FAA-STD-019, latest editions.

3.2 INSTALLATION

3.2.1 Installation, General:

Install lamps in luminaires and lamp holders and set units plumb, square and level with ceilings and walls, and secure according to manufacturer's installation instructions and approved Shop Drawings.

3.2.2 Finishes:

Check the architectural finishes and provide fixtures with proper trim, frames, and other hardware required to coordinate with the proper finishes, regardless of the specified or scheduled catalog numbers, prefixes and suffixes.

3.2.3 Support for Suspended Fixtures:

Brace pendants and rods over 48 inches long to limit swinging. Support stem-mounted, single-unit, suspended LED fixtures with trim-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.

3.2.4 Lamping:

Re-lamp units according to manufacturer's installation instructions.

3.2.5 Emergency Fixtures:

All emergency lighting fixtures must be (plug-in or hardwired).

3.2.6 Recessed Lighting:

Install recessed lights to permit removal from below. Install gird clips.

3.2.7 Hardware:

Install straps, mounting plates, nipples, and/or brackets for proper installation.

3.3 CONNECTIONS AND GROUNDING

3.3.1 Connectors and Terminals:

Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not specified, use those specified in UL 486A. Ground fixtures in accordance with FAA-C-1217, latest edition.

3.3.2 External Bonding Jumpers:

External bonding jumpers are not required across flexible metal conduit.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspection:

Inspect each installed fixture for damage. Replace damaged fixtures and components.

3.4.2 Notification:

Give advance notice of dates and times for field tests.

3.4.3 Instruments:

Provide instruments to make and record test results.

3.4.4 Tests:

Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting

installation. All fixtures must be energized upon completion of installation for a period of 72 hours, upon which Subcontractor must replace any lamps which are not operating properly.

3.4.5 Repair or Replacement and Retesting:

Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.4.6 Test Reports:

Report results of all tests.

3.4.7 Replacement:

Replace fixtures that show evidence of corrosion during Project warranty period.

3.5 ADJUSTING AND CLEANING

3.5.1 Pre-Inspection Cleaning:

Immediately before final inspection clean fixtures inside and out including plastics and glassware. Use methods and materials recommended by manufacturer.

3.5.2 Adjustment:

Adjust all trim, aim fixtures in the presence of the PM Designee to provide required light intensities.

3.5.3 Touch-Up:

Touch up luminaire finish at the completion of the work.

3.5.4 Part Replacement:

Replace broken or damaged parts.

3.5.5 Lamping and Testing:

Lamp and test all fixtures for electrical, as well as mechanical operation.

3.5.6 Relamping:

Relamp luminaires that have failed at completion of work.

3.5.7 Alignment:

Align luminaires and clean lenses and diffusers at completion of the work. Clean paint splatters, dirt, and debris from installed luminaires.

-- End of Section --

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS 0600334 (2024) Electrical Protection of Communications Towers and Associated Structures

ASTM INTERNATIONAL (ASTM)

ASTM B1 (2013) Standard Specification for Hard-Drawn Copper Wire

ASTM B8 (2023) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

BICSI International Standards Program (BICSI)

ANSI/BICSI N1 (2019) Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure

ANSI/BICSI N3 (2020) Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

BICSI TDMM (2024; 15th Edition) Telecommunications Distribution Methods Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2026) National Electrical Code

NFPA 780 (2026) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

ANSI/TIA-606 (2021d) Administration Standard for Telecommunications Infrastructure

ANSI/TIA-607 (2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-419 (1987; Rev A) Grounding, Bonding, and

Shielding for Electronic Equipments and
Facilities Volumes 1 of 2 Basic Theory

UFC 3-580-01

(2024) Information and Communications
Technology Infrastructure Planning and
Design

UL SOLUTIONS (UL)

UL 467

(2022) UL Standard for Safety Grounding
and Bonding Equipment

UL 486A-486B

(2025) UL Standard for Safety Wire
Connectors

UL 969

(2025) UL Standard for Safety Marking and
Labeling Systems

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification must be as defined in ANSI/TIA-607, BICSI TDMM, UFC 3-580-01, 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and herein.

1.3.1 Activity Specific Telecommunications Manager

Throughout this document, the term "Telecommunications Manager" or "Information Communications Technology (ICT) Manager refers to the following:

Army - the Network Enterprise Center (NEC) or the Information Officer (G6, S6, J6)

Navy - the Base Communications Officer (BCO) or the Naval Computer and Telecommunications Area Mater Station (NCTAMS) Regional Coordinator (RC)

Marine Corps - the Installation Communications-G6

Air Force - the Base/Installation Communications Squadron-A6.

1.3.2 Alternating Current Equipment Ground (ACEG) Bonding Conductor

A conductor installed from the alternating current equipment ground inside an electrical panel to a secondary bonding busbar or primary bonding busbar.

1.3.3 Backbone Bonding Conductor (BBC)

A telecommunication bonding connection which interconnects telecommunications bonding backbones (formerly known as the grounding equalizer)

1.3.4 Bonding Network (BN)

A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.

1.3.5 Electromagnetic Impulse (EMI)

Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

1.3.6 Mesh Bonding Network (mesh-BN)

A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to multiple points on the common bonding network (formerly known as the signal reference grid).

1.3.7 Mesh-Isolated Bonding Network (mesh-IBN)

A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to a single point on the common bonding network (formerly known as the isolated signal reference grid).

1.3.8 Primary Bonding Busbar (PBB)

A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the buildings service equipment (power) ground (formerly known as the telecommunications main grounding busbar).

1.3.9 Rack Bonding Busbar (RBB)

A busbar within a cabinet, frame, or rack.

1.3.10 Rack Bonding Conductor (RBC)

Bonding conductor from the rack bonding busbar to the telecommunications equipment bonding conductor.

1.3.11 Secondary Bonding Busbar (SBB)

A common point of connection for telecommunications system and equipment bonding to ground and located in satellite telecommunications rooms (formerly known as the telecommunications grounding busbar).

1.3.12 Secondary Bonding Conductor (SBC)

Bonding conductor from the secondary bonding busbar to the telecommunications bonding backbone.

1.3.13 Telecommunications Bonding Backbone (TBB)

A conductor that interconnects the primary bonding busbar to the secondary bonding busbar.

1.3.14 Telecommunications Bonding Conductor (TBC)

A conductor that interconnects the telecommunications bonding

infrastructure to the building's service equipment (power) ground (formerly known as the bonding conductor for telecommunications).

1.3.15 Telecommunications Drawings - T3

Drawings in accordance with ANSI/TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, ladder racks, and conduit), mechanical/electrical layout, and cabinet, rack, backboard, and wall elevations. Drawings must show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces, and cabinet/racks. Drawings must include a complete list of equipment and material, equipment rack details to include conduit and cable tray data, proposed layout and bonding of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

1.3.16 Telecommunications Drawings - T4

Detailed drawings of symbols and typical details such as labeling, bonding, installation procedures, detail racking, and raceways.

1.3.17 Telecommunications Drawings - T6

Drawings to include grounding riser diagrams

1.3.18 Telecommunications Equipment Bonding Conductor (TEBC)

A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

1.3.19 Unit Bonding Conductor (UBC)

A bonding conductor from equipment or a patch panel to a rack bonding busbar.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Bonding Busbar

Bonding Conductors

Bonding Components

SD-06 Test Reports

Grounding and Bonding System Test

SD-07 Certificates

Contractor Qualifications

Key Personnel Qualifications

Manufacturer Qualifications

Report Of Prior Installations

SD-10 Operation and Maintenance Data

Telecommunications Grounding and Bonding System

SD-11 Closeout Submittals

Record Documentation

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Work and equipment installation under this section must be performed by and provided by approved contractor(s) and key personnel. Qualifications must be provided for: the telecommunications grounding and bonding contractor, the telecommunications grounding and bonding installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience, and certifications of the contractor and all key personnel.

1.5.1.1 Contractor Qualifications

The contractor must be a firm which is regularly and professionally engaged in the business of the implementation, installation, and testing of the specified telecommunications grounding and bonding systems and equipment. The contractor must demonstrate experience in providing successful telecommunications grounding and bonding systems within the past three years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunications grounding and bonding system installations for the contractor.

1.5.1.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of providing implementation, installation, and testing of the specified telecommunications grounding and bonding systems and equipment. There may be one key person, or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel must demonstrate experience in providing successful telecommunications grounding and bonding systems within the past 5 years. Submit documentation for a minimum of three and a maximum of five successful telecommunications grounding and bonding system installations for the submitted key personnel. The initial bond between the ACEG busbar and the PBB/SBB must be installed by a licensed electrician. Supervisors, installers, and testers assigned to the installation of subsequent work of this system or any of its components must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current electrician's license and BICSI

certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers assigned to the installation and testing of this system or any of its components must have a minimum of 5 years' experience in the installation of the specified grounding and bonding components and training that is deemed equivalent by the COR. These must include factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Documentation for each key person must include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications grounding and bonding system proposed for this solicitation. Include specific experience in installing and testing telecommunications grounding and bonding systems and provide the names and locations of at least two project installations successfully completed using telecommunications grounding and bonding systems.

All the existing telecommunications grounding and bonding system installations offered by the key persons as successful experience must have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity. Indicate that all key persons are currently employed by the electrical contractor or telecommunications contractor or have a commitment to the electrical contractor or telecommunications contractor to work on this project. Note that only the key personnel identified in the approved submittals of the successful proposal, and approved by the Contracting Officer, are permitted to do work on this telecommunications grounding and bonding system. Key personnel must function in the same roles in the contract, as they functioned in the successful experience offered. Any substitutions for the telecommunications contractor's key personnel requires the resubmission of the qualifications and new approval from the Contracting Officer.

1.5.1.3 Minimum Manufacturer Qualifications

Cabling and equipment manufacturers must have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with ANSI/TIA-607

1.6 REGULATORY REQUIREMENTS

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "must" had been substituted for "shall" or "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 STANDARD PRODUCTS

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid

opening. The 2-year period must include applications for equipment and materials under similar circumstances and of comparable size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.7.1 Alternative Qualifications

Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, excluding the manufacturer's factory or laboratory tests, is provided.

1.7.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site must not be used, unless specified otherwise. Products must not be delivered to site earlier than 6 months prior to installation.

1.8 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage. Visual inspection, for damage, of all material must be performed prior to installation.

1.9 MAINTENANCE

1.9.1 Telecommunications Grounding and Bonding System

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for telecommunications grounding and bonding system that provide basic data relating to the design, operation, and maintenance of the telecommunications grounding and bonding system for the building. Include the following:

- a. Riser diagram of the "as-built" building telecommunications grounding and bonding system.
- b. Manufacturers' maintenance manuals on grounding and bonding hardware, bonding features of material, and installation requirements.

1.9.2 Record Documentation

Provide T3, T4, and T6 drawings including documentation on cables and termination hardware in accordance with UFC 3-580-01. Drawings must include enlarged floor plans, details, and grounding riser diagrams to show information for grounding and bonding locations and interconnection of grounding systems. Drawings must be provided in hard copy format on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, must be provided.

1.10 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract and as required in Section 01 78 00 CLOSEOUT SUBMITTALS.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of ANSI/TIA-607, NFPA 70, and NFPA 780 for all materials, equipment, and devices.

2.2 COMPONENTS

Components must be UL, or third party certified by a nationally recognized testing laboratory (NRTL). Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate must state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications grounding and bonding conductors and hardware. Provide support structures and pathways, complete with conductors, connecting hardware, and grounding busbars.

Conductors and interconnecting hardware and components for telecommunications grounding and bonding systems must be UL listed, or third-party independent testing laboratory certified and must comply with NFPA 70, ANSI/TIA-607, and conform to the requirements specified herein.

2.3 BONDING PRODUCTS

Provide in accordance with UL 467, ANSI/TIA-607, and NFPA 70. Components must be labeled as required by ANSI/TIA-606 and as indicated. Conductor sizes shown are based on copper, unless indicated otherwise.

2.3.1 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors must be installed using two-hole compression type lugs in accordance with ANSI/TIA-607 and UL 486A-486B.

2.3.1.1 Telecommunications Bonding Conductor (TBC)

Provide a copper TBC in accordance with ANSI/TIA-607 and BICSI TDMM. The TBC must be sized using IAEI calculations as described in BICSI TDMM Chapter 9 but must not be smaller than the largest TBB. The TBC must be sized at 2 kcmil per linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil. Provide TBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.]

2.3.1.2 Telecommunications Bonding Backbone (TBB)

Provide a copper TBB in accordance with ANSI/TIA-607. The TBB must be sized at 2 kcmil per linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil. Determine linear length as the shortest practical route between the PBB and the furthest SBB. Provide TBB with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.

2.3.1.3 Backbone Bonding Conductor (BBC)

Provide a copper BBC in accordance with ANSI/TIA-607. The BBC must be sized at 2 kcmil per linear foot with a minimum size of No. 6 AWG but must not be smaller than the largest TBB to which it is connected. Provide BBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.

2.3.1.4 Alternating Current Equipment Ground (ACEG) Bonding Conductor

Provide a copper ACEG Bonding Conductor in accordance with ANSI/TIA-607 and BICSI TDMM. The ACEG Bonding Conductor must be sized using IAEI calculations as described in BICSI TDMM Chapter 9, but must not be smaller than the largest TBB. Provide ACEG Bonding Conductor with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.

2.3.1.5 Rack Bonding Conductor (RBC)

Provide a copper Rack Bonding Conductor (RBC) in accordance with ANSI/TIA-607. Provide RBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. RBC must be at a minimum No. 6 AWG. ANSI/TIA-607 Figure 8, Example "A" is not allowed and an RBC must not be substituted for an Rack Bonding Busbar (RBB) in any location.

2.3.1.6 Secondary Bonding Conductor (SBC)

Provide a copper Secondary Bonding Conductor (SBC) in accordance with ANSI/TIA-607. Provide SBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. At a minimum, the SBC must be the greater of No. 6 AWG or the largest conductor bonded to the associated SBB.

2.3.1.7 Telecommunications Equipment Bonding Conductor (TEBC)

Provide a copper TEBC in accordance with ANSI/TIA-607. Provide TEBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. The TEBC must be continuous and sized not less than a No. 6 AWG or as the largest size equipment grounding conductor in the branch power circuit(s) serving the rack/cabinet lineup. Cable shields, metal conduit, cable runway or ladder, or any other metallic cable pathway do not satisfy the requirements for a TEBC.

2.3.1.8 Unit Bonding Conductor (UBC)

Provide a copper UBC in accordance with ANSI/TIA-607 for appliances that have manufacturer bonding connections available. Provide UBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

paragraph INSULATION. Size UBC per telecommunications equipment manufacturer recommendations. UBC must be at a minimum No. 12 AWG. Bonding per Example "A" of ANSI/TIA-607 is not permitted.

2.3.1.9 Structural Metal Bonding Conductor

Provide a copper structural metal bonding conductor in accordance with ANSI/TIA-607. Provide structural metal bonding conductor with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. The structural metal bonding conductor must be sized at 2 kcmil per linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil.

2.3.1.10 Cable Tray Bonding Jumper

Bonding jumpers or mechanical bonds supplied by the cable tray manufacturer must provide a maximum bonding resistance of 1 milliohm. If not supplied by the cable tray manufacturer or if unable to meet the maximum bonding resistance requirements, provide a copper bonding jumper across connection points in accordance with ANSI/TIA-607. Provide cable tray bonding jumper with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. Provide cable tray bonding jumpers not smaller than 10 AWG and not longer than 12 in. If jumper is wire, it must be terminated with lugs having two holes and long barrel for two crimps. If jumper is flexible braid, it must be terminated with two-hole ferrule. Attach with bonding screw or connector provided by cable tray manufacturer.

2.3.2 Bonding Busbar

Provide isolated, corrosion-resistant bonding busbar suitable for indoor installation in accordance with ANSI/TIA-607. Busbars: plated for reduced contact resistance. Provide a Primary bonding busbar (PBB) in the telecommunications entrance facility. The PBB and the SBB: sized in accordance with the immediate application requirements and with consideration of future growth. Provide vertical Rack Bonding Busbar (RBB) in each rack cabinet. Provide bonding busbars with the following:

- a. Predrilled copper busbar provided with holes for use with standard sized two-hole lugs.
- b. Minimum dimensions of 0.25 in thick by 4 in wide for the PBB and SBBs with length as required for the number of terminations plus 50 percent with a minimum length of 12 in.
- c. Minimum stand-off distance of 2 in for the PBB and 2 in for the SBB and 0.75 in for the RBB. The PBB, SBBs and RBBs must be insulated from supports using insulators that are listed for the purpose.
- d. Listed by a nationally recognized testing laboratory.

2.3.3 Bonding Components

2.3.3.1 Exothermic Weld

Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

2.3.3.2 Irreversible Compression-Type Connectors

Make irreversible compression type connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed.

2.3.4 Mesh Bonding Network (mesh-BN)

Provide a mesh-BN in accordance with MIL-HDBK-419 and as specified herein.

2.3.4.1 Access Floor mesh-BN

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing No. 6 AWG bonding conductors in a grid pattern under the floor. Bond the mesh-BN conductors every 12 ft in each direction using listed pedestal ground clamps.

2.3.4.2 mesh-BN - Wire Mesh

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing wire mesh in concrete floor slab with No. 10 AWG.

2.3.4.3 mesh-BN - Grid Tape

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing tape mesh under floor finish 2 in by 16 mil solid copper.

2.3.5 Mesh-Isolated Bonding Network (mesh-IBN)

Provide a mesh-IBN in accordance with MIL-HDBK-419 and as specified herein.

2.3.5.1 Access Floor mesh-IBN

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing No. 6 AWG bonding conductors in a grid pattern under the floor. Bond the mesh-IBN conductors every 12 ft in each direction using listed pedestal ground clamps.

2.3.5.2 mesh-IBN - Wire Mesh

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing wire mesh in concrete floor slab with No. 10 AWG.

2.3.5.3 mesh-IBN - Grid Tape

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing tape mesh under floor finish 2 in by 16 mil solid copper.

2.4 LABELS

Comply with ANSI/TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label

printers.

- a. Brass Tag: Pre-pressed, 1-1/2 inch diameter brass label with the words "DO NOT DISCONNECT".
- b. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- c. Snap-Around Labels: Slit, pretensioned flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.
- d. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
 - (1) Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - (2) Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- e. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - (1) Minimum Nominal Size:
 - (a) 1-1/2 by 6 inches for raceway and conductors.
 - (b) 3-1/2 by 5 inches for busbars.

2.5 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING. Ends of conduit stubs must be treated as part of the overall assembly.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for 5 ohm maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- b. Inspect test results of grounding system measured at point of TBC connection.
- c. Prepare written report of prior installations, endorsed by Installer, listing conditions detrimental to performance of the Work.
- d. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Grounding through the equipment Alternating Current (AC) power cord does not meet the intent of this specification. Information technology equipment must be provided with a supplementary and specific ground path for the equipment over and above the required alternating current or direct current power ground path. Install all grounding and bonding conductors in accordance with ANSI/BICSI N3, ANSI/TIA-607, and manufacturer's published instructions.

3.2.1 Bonding Conductors

Bonding conductors must not be placed in ferrous metallic conduit unless otherwise required by NFPA 70. If it is necessary to place bonding conductors in ferrous metallic conduit, bond the conductors to each end of the conduit using a grounding bushing where the bonding jumper is the same size or larger than the bonding conductor. Outside of telecommunications spaces, install conductors in trade size 3/4 conduit in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Bonding conductors routed through ferrous metallic enclosures must be bonded to the enclosure with a grounding bushing where the bonding jumper is the same size or larger than the bonding conductor.

Stacking of conductors under a single bolt is not permitted. Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows: Use crimping tool and die specific to the connector, pre-twist the conductor, and apply antioxidant compound to bolted and compression connections.

Install all bonding conductors to the maximum extent possible without splices and routed in the shortest possible straight-line path. Where splices are necessary, the number of splices are to be minimized as much as possible. Make necessary splices accessible and located in telecommunications spaces. Make necessary splices using exothermic welding or irreversible compression-type connectors. Install all joints to be adequately supported and protected from damage. Support conductors at not more than 36 in intervals.

Bends of bonding conductors terminating at the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) must have a minimum inside bend radius of 8 in. At other locations, make bends in bonding conductors with the greatest practical inside bend radius. A minimum bend radius of 10 times the bonding conductor diameter is recommended. A minimum included angle of 90 degrees must be used.

3.2.1.1 Telecommunications Bonding Conductor (TBC)

Install a TBC between the PBB and service equipment power ground.

3.2.1.2 Telecommunications Bonding Backbone (TBB)

The TBB must: be connected to the PBB, be consistent with the design of the telecommunications backbone cabling system, permit multiple TBBs as necessary, be continuous from the PBB to the furthest SBB to which it is connected, and minimize, to the extent practical, the lengths of the TBB(s). The TBB conductors must be protected from physical and mechanical damage. Metallic cable shield(s) or any metal pathway for cable must not be used as a TBB nor water piping systems be used as a TBB.

3.2.1.3 Bonding Backbone Conductor (BBC)

Provide a Bonding Backbone Conductor (BBC) between all TBBs in a multistory building at the top floor, and at a minimum of every third floor in between to the lowest floor level. The BBC must be bonded to the associated SBB utilizing exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

3.2.1.4 Bonding Conductors for Connections to the mesh-BN or RBB

Bonding conductors used to bond components to the mesh-BN or RBB must: be stranded copper conductors, be neatly routed and no longer than practical to bond the component to the mesh-BN or RBB, be secured at no greater than 3 ft intervals, not be routed so as to create a tripping hazard or impair access to equipment, not be attached with any method that could damage the conductors, be listed as suitable for bonding applications, and be available for use in the space in which they will be placed. [Where uninsulated conductors are utilized, they must be supported by standoff insulators at intervals no greater than 2 ft or be contained in electrical non-metallic tubing (ENT). Uninsulated bonding conductors must not be in contact with metallic surfaces or other conductors that are not part of the telecommunications grounding and bonding system.]

3.2.1.5 Telecommunications Equipment Bonding Conductor (TEBC)

Install a TEBC between the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) and the equipment Rack Bonding Busbar (RBB). Provide a separate TEBC per rack or cabinet. The TEBC must be continuous from the PBB or SBB and the furthest RBB. Connections to the TEBC must be made with listed compression connections, suitable for multiple conductors, and with the Rack Bonding Conductors (RBCs) routed toward the PBB or SBB. Cable shields, metal conduit, cable runway or ladder, or any other metallic cable pathway do not satisfy the requirements for a TEBC. The TEBC may be routed within cable trays, on the outside of ladder rack tray supported at no greater than 3 ft intervals, or along equipment platforms. The TEBC must be separated a minimum of 2 in from conductors of other cable groups, except when conductors are grouped together to enter or exit an enclosure, and ferrous material. In locations where TEBC cannot meet separation requirements from ferrous material, bond the TEBC to the ferrous material.

3.2.1.6 Unit Bonding Conductor (UBC)

Install a UBC between the Rack Bonding Busbar (RBB) and the cabinet/rack mounted equipment. The UBC must be connected to the RBB using a listed compression connection and to the grounding post of the cabinet/rack mounted equipment per manufacturer's instructions. Only bond equipment that has manufacturer bonding connections available.

3.2.2 Bonding Busbar

3.2.2.1 Primary Bonding Busbar (PBB)

Install a Primary Bonding Busbar (PBB) as close as practical to the panelboard serving the Telecommunications Entrance Facility (TEF) and located within the TEF while providing the shortest and straightest practical routing of the Telecommunications Bonding Conductor (TBC). Maintain clearances as required by NFPA 70. Mount the PBB 18 in as

indicated. The PBB and the electrical service ground, where the grounding electrode conductors are bonded together, serve separate purposes and must be two separate busbars even when both are located in the same room or area.

Bonds to the PBB:

- a. Panelboard: Bond all panelboard Alternating Equipment Ground (ACEG) busbars or panelboard enclosures serving the TEF equipment to the PBB using an ACEG Bonding Conductor.
- b. Primary Protector: Bond the primary protector grounding conductor to the PBB. A minimum of 1 ft separation must be maintained between this conductor and any direct current power cables, switchboard cable, or high frequency cables, even when placed in metal conduit.
- c. Outside Plant Cables: Bond the cable shield on the building side of the cable shield isolation gap to the PBB.
- d. Structural Metal: Where structural metal is accessible and in the same room as the PBB, bond the structural metal to the PBB using a structural metal bonding conductor. When practical, because of shorter distances and where horizontal steel members are permanently electrically bonded to vertical column members, the PBB may be bonded to horizontal members in lieu of vertical column members. When the structural metal is external to the room, but readily accessible, bond the structural metal to the PBB using a structural metal bonding conductor.
- e. Metallic Pathways: Bond all metallic telecommunications pathways 3 ft or greater to the PBB with a minimum No. 6 AWG in accordance with ANSI/BICSI N3. For metallic pathways containing bonding conductors where the pathway is bonded to the bonding conductor, no additional bond is required.
- f. Cable Tray: Bond cable tray or runway to the PBB with a cable tray equipment grounding conductor.
- g. Electrical Service Ground: Provide a TBC between the PBB and readily accessible grounding connection of the electrical service in accordance with ANSI/TIA-607, BICSI TDMM, and NFPA 70 Section 250.94.
- h. Telecommunications Bonding Backbone (TBB): Provide a TBB between the PBB and the furthest Secondary Bonding Busbar (SBB) in accordance with ANSI/TIA-607.
- i. Telecommunications Equipment Bonding Conductor (TEBC): Provide a TEBC between the PBB and each Rack Bonding Busbar (RBB) the farthest Rack Bonding Busbar (RBB).
- j. Electronic Security System (ESS): Bond all ESS equipment located within the TEF to the PBB.

The connection of conductors for bonding telecommunications equipment and pathways to the PBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

3.2.2.2 Secondary Bonding Busbar (SBB)

Install a minimum of one Secondary Bonding Busbar (SBB) in all other telecommunications spaces. Multiple SBBs may be installed within the same telecommunications space to aid in minimizing bonding conductor lengths and minimizing terminating space. Locate the SBB as close as practical to the panelboard serving the telecommunications space and located within the telecommunications space. Maintain clearances as required by NFPA 70. Mount the PBB[[18 in][6.5 ft] above finished floor as indicated.

Bonds to the SBB:

- a. Panelboard: Bond all panelboard Alternating Equipment Ground (ACEG) busses serving the telecommunications space equipment to the SBB using an ACEG Bonding Conductor.
- b. Telecommunications Bonding Backbone (TBB): At SBB(s) located furthest from the PBB, bond the TBB to the SBB(s).
- c. Secondary Bonding Conductor (SBC): Where the SBB is not directly bonded to the TBB, install an SBC between the TBB and the SBB. The SBC must be continuous and routed in the shortest practical straight-line path.
- d. Other SBBs: All SBBs located within the same telecommunications space must be bonded together with a conductor the same size as the TBB splice bars.
- e. Structural Metal: Where structural metal is accessible and in the same room as the SBB, bond the structural metal to the SBB using a structural metal bonding conductor. When practical, because of shorter distances and where horizontal steel members are permanently electrically bonded to vertical column members, the SBB may be bonded to horizontal members in lieu of vertical column members. When the structural metal is external to the room, but readily accessible, bond the structural metal to the SBB using a structural metal bonding conductor.
- f. Metallic Pathways: Bond all metallic telecommunications pathways 3 ft or greater to the SBB with a minimum No. 6 AWG in accordance with ANSI/BICSI N3. For metallic pathways containing bonding conductors where the pathway is bonded to the bonding conductor, no additional bond is required.
- g. Cable Tray: Bond cable tray or runway to the SBB with a cable tray equipment grounding conductor
- h. Telecommunications Equipment Bonding Conductor (TEBC): Provide a TEBC between the SBB and each Rack Bonding Busbar (RBB).
- i. Electronic Security System (ESS): Bond all ESS equipment located within the telecommunications space to the SBB.

The connection of conductors for bonding telecommunications equipment and pathways to the SBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

3.2.2.3 Rack Bonding Busbar (RBB)

Install a vertical or horizontal Rack Bonding Busbar (RBB) in each telecommunications cabinet or rack.

Bonds to the RBB:

- a. Telecommunications Equipment Bonding Conductor (TEBC): Bond a TEBC to a listed compression two-hole lug in the RBB in the telecommunications space. For all other RBBs within the space, bond the RBB to the TEBC with a Rack Bonding Conductor (RBC). The connection of the TEBC or RBC to the RBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.
- b. Cabinet and Rack: Bond the cabinet or rack to its associated RBB using a Rack Bonding Conductor (RBC). The connection of the RBC to the RBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.
- c. Cabinet and Rack Mounted Equipment: Equipment containing metallic parts and patch panels for shielded cabling within cabinets and racks must be bonded to the RBB using a Unit Bonding Conductor (UBC). The UBC must be connected to the RBB using a listed compression connection and to the grounding post of the telecommunications equipment if provided. Only bond equipment that has manufacturer bonding connections available.

3.2.3 Telecommunications Cabling

Metallic sheaths of OSP cables must be bonded to the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] as close as practical to the point of entrance in accordance with ANSI/TIA-607 and manufacturer's instructions.

Telecommunications backbone cabling incorporating a shield or metallic member must have the shield or metallic member bonded to the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] where the cables are terminated or where pairs are "broken out" from the cable sheath in accordance with ANSI/TIA-607 and manufacturer's instructions.

The secondary protector grounding conductor or terminal must be connected to the nearest Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] using the shortest practical path in accordance with ANSI/TIA-607 and manufacturer's instructions.

3.2.4 Mesh Bonding Network (mesh-BN)

3.2.4.1 Access Floor mesh-BN

- a. Provide access floor with integral means to bond the flooring grid as part of the structure 12 ft centers, to permit bonding of every fourth pedestal using listed pedestal ground clamps. Connect grid conductors together where they cross each other.
- b. Bond PBB or SBBs in room to two or more bonding conductors of reference grid with TEBCs.
- c. Bond equipment to nearest PBB or SBB and to mesh-BN with TEBCs.

- d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB or SBB and to grid conductor nearest entry into room.

3.2.4.2 mesh-BN - Wire Mesh

- a. Install grid bonding conductors on 24 in centers. Connect grid conductors together where they cross each other.
- b. Bond PBB or SBBs in room to two or more bonding conductors of reference grid with TEBCs.
- c. Bond equipment to nearest PBB or SBB and to mesh-BN with TEBCs.
- d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB[or SBB] and to grid conductor nearest entry into room.

3.2.4.3 mesh-BN - Grid Tape

- a. Install mesh tape on 24 in centers. Connect mesh tape together where they cross each other.
- b. Bond PBB in room to two or more bonding conductors of reference grid with TEBCs.
- c. Bond equipment to nearest PBB and to mesh-BN with TEBCs.
- d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB and to grid conductor nearest entry into room.

3.2.5 Mesh-Isolated Bonding Network (mesh-IBN)

3.2.5.1 Access Floor mesh-IBN

- a. Provide access floor with integral means to bond the flooring grid as part of the structure. Install grid bonding conductors on 8 ft centers, to permit bonding of every sixth pedestal using listed pedestal ground clamps. Connect grid conductors together where they cross each other.
- b. Bond PBB in room to a single bonding conductor of reference grid with TEBC.
- c. Bond equipment to mesh-IBN with TEBCs.
- d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

3.2.5.2 mesh-IBN - Wire Mesh

- a. Install grid bonding conductors on 24 in centers. Connect grid conductors together where they cross each other.
- b. Bond PBB or SBBs in room to a single bonding conductor of reference grid with TEBC.
- c. Bond equipment to mesh-IBN with TEBC.
- d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

3.2.5.3 mesh-IBN - Grid Tape

- a. Install mesh tape on 24 in centers. Connect mesh tape together where they cross each other.
- b. Bond PBB[or SBBs in room to a single bonding conductor of reference grid with TEBC.
- c. Bond equipment to mesh-IBN with TEBCs.
- d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

3.2.6 Cabinets and Racks

Metallic enclosures, including telecommunications cabinets and racks, must be bonded to the mesh-BN, mesh-IBN, PBB or SBB using a minimum sized No. 6 AWG. Cabinets, racks, and other enclosures must not be bonded serially; each must have its own dedicated bonding conductor to the mesh-BN, PBB, SBB or TEBC. Equipment containing metallic parts and patch panels for shielded cabling in cabinets and racks must be bonded to the telecommunications bonding system in accordance with ANSI/TIA-607 and manufacturer's instructions, a minimum No. 12 AWG conductor. For bolted cabinets and racks, bonding hardware must be specifically designed to accomplish integral bonding of the cabinet and rack assembly, frame, and support, and tested to meet applicable third-party nationally recognized testing laboratory requirements. All detachable, metallic parts of equipment cabinets and racks must be bonded, either directly by means of bonding jumpers or through the cabinet frame, to the connection point on the cabinet where the cabinet bonding conductor connects to the cabinet. When a detachable, metallic part of an equipment cabinet or rack is connected by a bonding jumper, the bonding jumper must be a minimum No. 12 AWG stranded, high strand count, insulated copper conductor with green or green with yellow stripe jacket. The bonding jumper must have an easily visible quick connect to facilitate detaching and attaching the panel or door.

3.2.7 Cable Tray Connections

Provide cable tray bonding with mechanical bonds supplied by the cable tray manufacturer or a bonding jumper between connected sections of cable tray or runway. Test bonding connections to ensure a maximum bonding resistance of 1 milliohm.

3.2.8 Grounding and Bonding for Towers and Antennas

The installation must meet the grounding and bonding requirements of ATIS 0600334.

3.2.8.1 Ring Electrode

Install a minimum 30 in below grade and a minimum 24 in from base of tower or mounting. Bond each tower base and metallic frame of dish to ring electrode, buried a minimum 18 in below grade. Bond ring electrode and antenna bonding conductors to equipment room PBB or SBB, buried a minimum 30 in below grade. Bond metal fences located within 6 ft of towers and antennas to ring electrode, buried a minimum 18 in.

3.2.8.2 Roof-Mounted Towers

Provide a roof ring that meets the requirements for ring electrode except conductors must comply with NFPA 780. Bond tower base footings steel, PBB[or SBB] in equipment room, and antenna support guys to roof ring. Connect roof ring to perimeter conductors of lightning protection system.

3.2.8.3 Waveguides and Coaxial Cable

Bond cable shields at point of entry into building to the external grounding system using at minimum No. 2 AWG bonding conductors. Once cable is inside building, connect cable shields to building interior grounding system using a minimum No. 6 AWG bonding conductor. Metallic entrance plates must be bonded to cables using a minimum No. 2 AWG bonding conductor for exterior of building, and No. 6 AWG for interior of building. Bond coaxial cable surge arrester to ring electrode or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.3 IDENTIFICATION

3.3.1 Labels

Provide labeling in accordance with ANSI/TIA-606, UFC 3-580-01, and as designed. Handwritten labeling is unacceptable. Stenciled lettering for grounding must be provided using thermal ink transfer process or laser printer.

3.3.2 Cable

Cables must be labeled with To/From information on opposing ends with identifiers as provided in design drawings and in accordance with ANSI/TIA-606.

Cables terminated on the PBB and SBBs must have "DO NOT DISCONNECT" brass tags installed at the termination point.

3.3.3 Termination Hardware

Bonding busbars must be labeled using yellow labels with verbiage/identifiers as approved by Telecommunications Manager in accordance with ANSI/TIA-606, UFC 3-580-01, and as designed.

3.4 FIELD QUALITY CONTROL

Provide test equipment and personnel and submit written copies of test results. Technicians who have successfully completed a training program for the test equipment and hold a current certificate as proof thereof must execute the tests. Give Contracting Officer 5 working days notice prior to each test. Test grounding and bonding system in accordance with ANSI/TIA-607.

3.4.1 Inspection

Prior to performing testing, a visual inspection must be performed to verify all components are installed in accordance with ANSI/TIA-607, NFPA 70, ANSI/BICSI N3, NFPA 780, ATIS 0600334 and MIL-HDBK-419. Verify tightness of accessible, bolted electrical connections with calibrated torque wrench according to manufacturer's published instructions.

3.4.2 Grounding and Bonding System Test

- a. Test structural metal using a two-point test in accordance with ANSI/TIA-607 to verify its conductivity to the building's electrical grounding electrode system before making connection of structural metal bonding conductors.
- b. Test the electrical grounding electrode system using a three-point fall-of-potential method in accordance with ANSI/TIA-607 before making connection of TBC. The electrical grounding system must not exceed 5 ohms resistance. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Document and submit test results in accordance with paragraph SUBMITTALS.
- c. Bonding system testing is required to determine if an acceptable level of resistance is provided between the telecommunications bonding system and the electrical grounding electrode system. Perform bonding testing on all segments of the bonding system using a two-point test in accordance with ANSI/TIA-607 and ANSI/BICSI N1. Testing must be performed prior to the installation of any telecommunications equipment. A maximum value of resistance between any two points in the telecommunications bonding system must be less than 100 micro-ohms and to the buildings electrical grounding electrode system must be less than 50 milliohms. Document and submit test results in accordance with paragraph SUBMITTALS.
- d. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 amperes, displaying current in increments of 0.01 ampere accuracy of plus or minus 2.0 percent. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to the PBB and SBBs. Maximum acceptable alternating current level is 1 ampere. Document and submit test results in accordance with paragraph SUBMITTALS.
- e. Test for stray direct current voltages using direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. With grounding infrastructure completed and communications system electronics operating, measure voltage in bonding conductors connected to the PBB and SBBs. Maximum acceptable direct current voltage level is 3 millivolts.

Final labeling must be verified as part of testing and certified as accurate per record documentation.

Telecommunications grounding and bonding will be considered defective if it does not pass tests and inspections. Remove and replace defective units and retest.

3.5 PROTECTION

After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance.

-- End of Section --